WATER WORKS & SEWERAGE

A GILLETTE ABP ABC PUBLICATION

EDITOR

OCTOBER 1937
VOLUME 84, No. 10

SERVICE 39

and still going strong!

Here's proof of dependability and long life. The above meter was sold to the City of Columbia in 1898. It was recently cleaned and reinstalled.

W. S. TOMLINSON
CITY ENGINEER

CITY OF COLUMBIA
OFFICE OF CITY ENGINEER
COLUMBIA, SOUTH CAROLINA

June 19, 1937.

Water Plant.

Pittsburgh Equitable Meter Co.,
400 Lexington Ave.,
Pittsburgh, Pa.

Gentlemen:

On June 15th, 1937, our Meter and Service Department removed one of your meters bearing the Serial No. 11786.

Records show that this meter has been in continuous service about 38 years with no repairs except a new clock or register.

Will you please check your records and see if this meter was installed in 1898 or in 1899. We are trying to establish the exact date that Columbia began metering its services.

Any information that you can give us about this meter, or if you can give us the exact date you sold the City of Columbia the first meter would be appreciated.

Yours truly,

Guy H. White

Guy H. White,
Columbia Water Plant.

H. O'B. BELLIN
ASST. ENGINEER

PITTSBURGH EQUITABLE METER CO.
MERCO NORDSTROM VALVE CO.
MAIN OFFICES PITTSBURGH, PA.

NEW YORK	LOS ANGELES	TULSA	HOUSTON	MEMPHIS	BUFFALO
COLUMBIA	KANSAS CITY	CHICAGO	PHILADELPHIA	ATLANTA	OAKLAND

PITTSBURGH WATER METERS

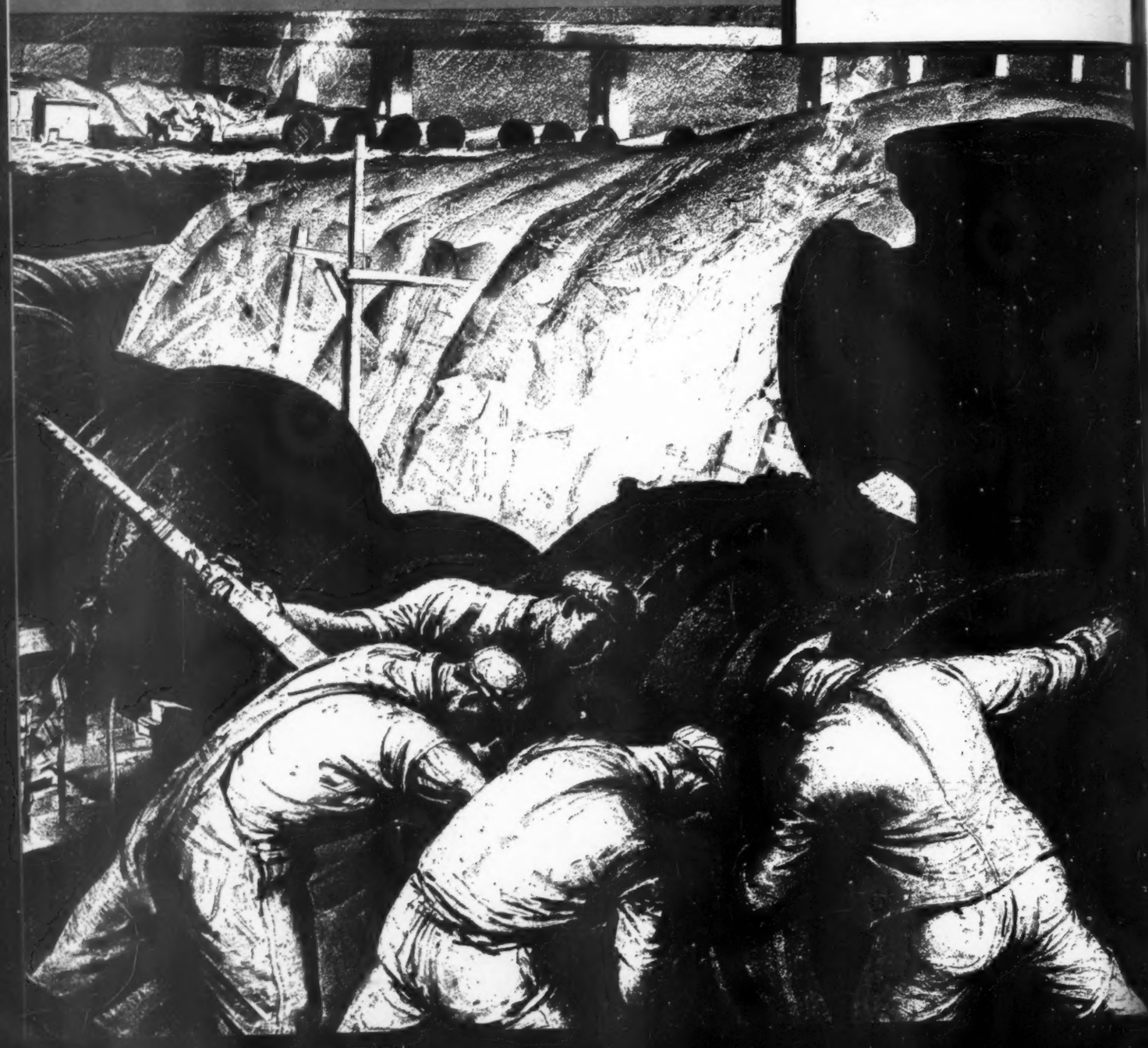
FOR UNUSUAL NEEDS in any field of pipe service—such as large and complicated special castings, alloy cast iron pipe for super-corrosive conditions, emergency requirements in pipe or fittings where quick delivery is mandatory—you can rely on U. S. service. Our foundry facilities, always extensive, have recently been further augmented. Our technical staff and equipment are resourceful. Our ability to meet strict delivery schedules and rush requirements is fortified by foundries, and complete stocks of pipe and fittings, at strategic locations. For unusual needs, rely on U. S.

Lithographed on stone by James E. Allen for U. S. Pipe & Foundry Co. Copyright 1937 by U. S. Pipe & Foundry Co.

U.S.
cast iron
PIPE

Cast iron and alloy cast iron pipe centrifugally or pit cast—for water works, gas, sewerage and drainage service as well as industrial uses involving corrosives.

U. S. PIPE & FOUNDRY CO.
BURLINGTON, NEW JERSEY
Foundries and Sales Offices throughout the U. S.



IF TYPHOID CAME OUT!

● A whole city can be wiped out almost overnight if typhoid should come out of the water tap. But it doesn't, thanks to the bacteriologist, the sanitary engineer, the water chemist—and Liquid Chlorine!

Every day and night—though the river overflows its banks, though the wind whips into hurricanes and the earth shakes and cracks, water-works men depend on their Chlorine supply to ward off the diseases men used to call plagues.

Solvay's "BIG 3" Service is a service on which water-works engineers can *always* depend for Liquid Chlorine . . . depend upon for quick, efficient deliveries and for technical cooperation and assistance when it is required!

Solvay Liquid Chlorine is now shipped from Syracuse, New York; Hopewell, Virginia; and upon announcement during the early part of 1938, will be shipped from the new Solvay Liquid Chlorine plant at Baton Rouge, Louisiana. Inquiries on Solvay Liquid Chlorine are cordially solicited from state and municipal water-works departments, and from manufacturers and other users.

SOLVAY SALES CORPORATION

Alkalies and Chemical Products Manufactured by The Solvay Process Company

40 Rector Street New York

BRANCH SALES OFFICES:

Boston					Pittsburgh
Charlotte	Cincinnati	Detroit	Kansas City	New York	St. Louis
Chicago	Cleveland	Indianapolis	New Orleans	Philadelphia	Syracuse

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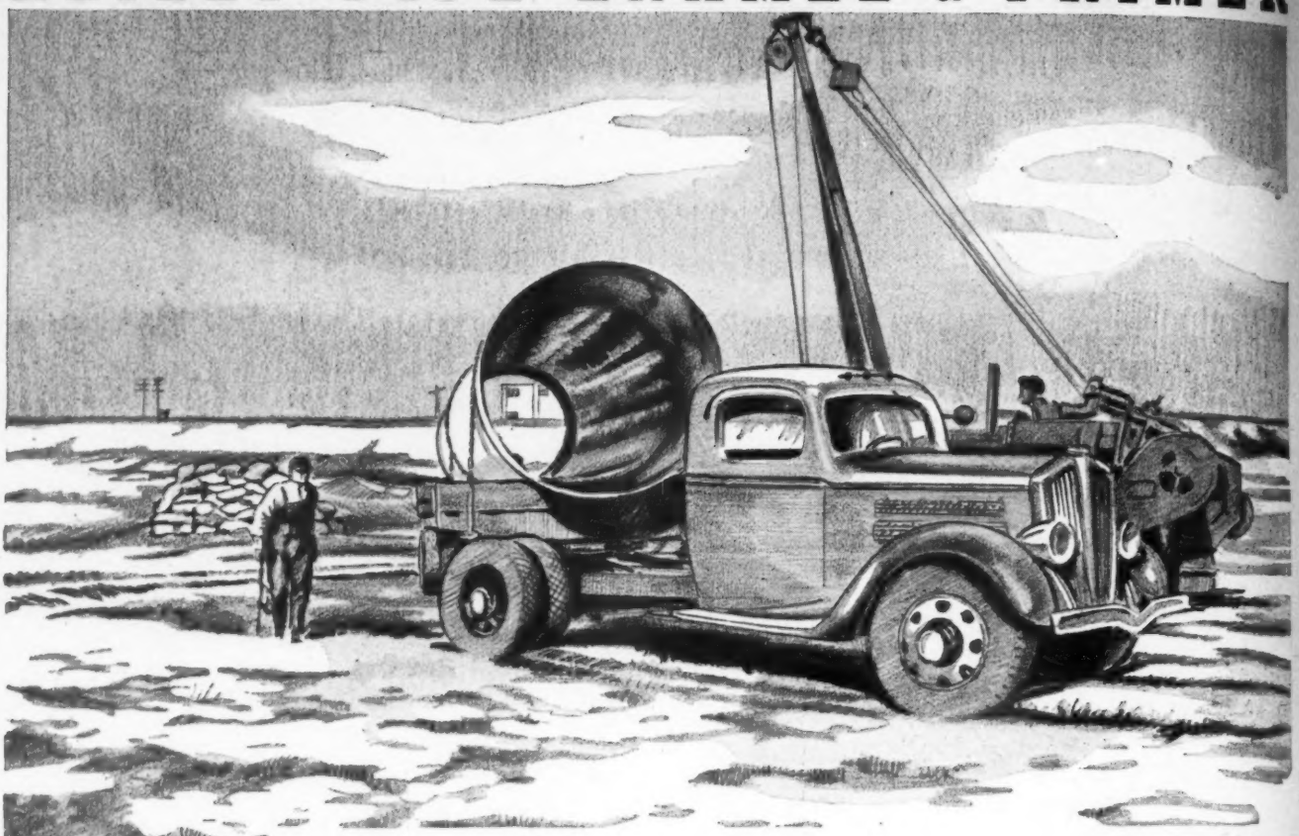
REILLY PIPE ENAMEL & PRIMER



Lasting Protection for Steel Pipe

The life of steel pipe is dependent upon the protective value of its coating. Engineers everywhere recognize the dependability of Reilly coatings and rely upon them for positive protection.

Reilly Enamel and Primer provide a bond between the coating and the steel that is unequaled. Reilly coatings withstand extreme changes in temperature without sagging or checking and give maximum protection against soil acids, alkalies and electrolysis. Reilly Pipe Enamel lining for water lines assures full capacity flow indefinitely . . . Tuberculation, incurstation and bacterial growth cannot take hold on the surface presented by Reilly Enamel.

We shall be glad to have your inquiries and your special protective coating problems will have our prompt and careful attention.

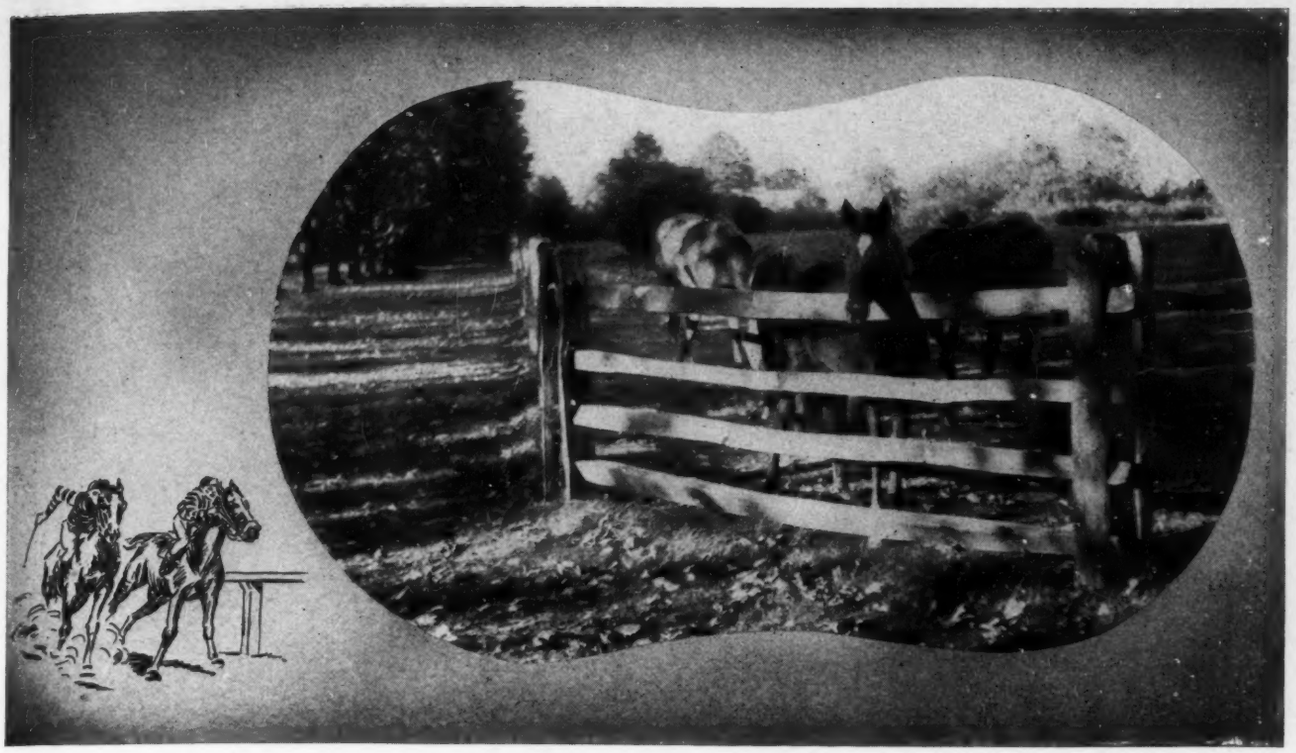
Reilly
COAL TAR PRODUCTS

REILLY TAR & CHEMICAL CORPORATION

Executive Offices: Merchants Bank Building, Indianapolis, Indiana

2513 S. DAMEN AVENUE, CHICAGO, ILLINOIS 500 FIFTH AVENUE, NEW YORK, N. Y. ST. LOUIS PARK, MINNEAPOLIS, MINN.

FIFTEEN PLANTS TO SERVE YOU



PREPARATION . . .

THE public seldom realizes the preparation required in producing water suitable for household needs. Careful as the personnel may be in preparing water free from bacteria and suspended matter, nevertheless, if tastes and odors are present in the tap Mr. John Public in the smaller communities will usually resort to water from unauthorized sources, in the belief that the sparkling glass of well, or spring water, represents the "tops." Case history is replete with serious epidemics resulting from the use of unauthorized sources of water.

In the larger communities, when tastes and odors break through, Mr. and Mrs. John Public and their neighbors rise in protest and flood the Water Department with complaints, abuses, etc. The local press, with their headlines, play this situation up as important news and frequently it either results in the dismissal or the non-appointment of personnel who have well served their Municipality.

Why not follow the lead of many Municipalities in feeding ACTIVATED CARBON daily so that when serious tastes and odors are present in the raw water supply, the plant has already been seeded with ACTIVATED CARBON and all that is necessary is to step up the dose in order to furnish a palatable water free from complaint.

Our Service Men are prepared to run Threshold Tests in your Plant, to show where the application of ACTIVATED CARBON will give you the most economical use.

We have released to over 1,000 newspapers a resumé of the treatment water is given to make it fit for household use with the idea of building up Good-Will for the water personnel. Mimeographed copies are available to water men in the event they wish to use it with their local newspaper.

Make your plans now to attend the Annual Convention of the Southwest Section of the American Water Works Ass'n to be held October 18-21, 1937, at the Hotel Galvez, Galveston, Texas.

NUCHAR AQUA

INDUSTRIAL CHEMICAL SALES

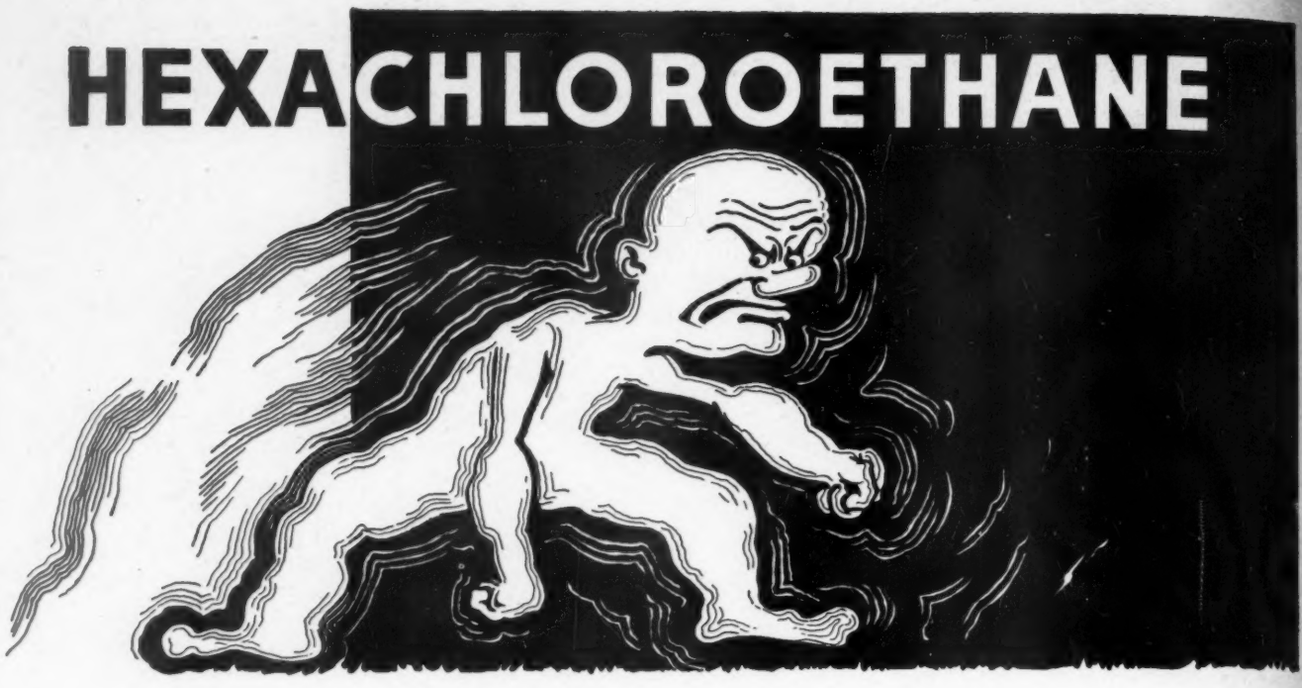
DIVISION WEST VIRGINIA PULP AND PAPER COMPANY

230 Park Avenue
New York, N. Y.

417 Schofield Building
Cleveland, Ohio

205 West Wacker Drive
Chicago, Illinois

HEXACHLOROETHANE



. . . one common trouble-maker that you need never encounter

A forbidding name for a mean substance—*hexachloroethane* is the impurity in liquid chlorine that causes most chlorinator irregularities. It is the chief constituent in "taffy".

Taffy is a common trouble-maker, but it is one that Pennsylvania Salt Manufacturing Company absolutely eliminates from the liquid chlorine supplied to you. Here is another instance of the progressive measures adopted by this Company to assure you a product of the highest purity.

This Company is equipped to supply liquid chlorine in any desired quantity with the utmost promptness. Our highly specialized technical service is always available to help with your difficult problems.

Liquid Chlorine

PENNSYLVANIA SALT MANUFACTURING COMPANY · Est. 1850

Widener Bldg., Philadelphia, Pa.

Offices: New York · Chicago · St. Louis · Pittsburgh · Tacoma · Wyandotte

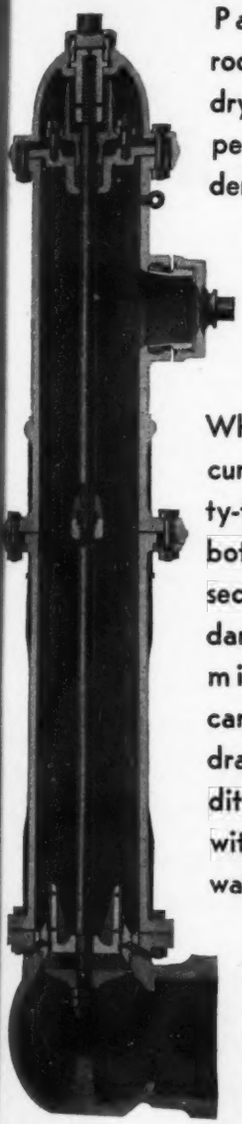
TRADE MARK

PENNSYLVANIA SALT *Chemicals*

MUELLER COLUMBIAN

FIRE HYDRANT

The entire top working mechanism of the MUELLER-COLUMBIAN is sealed away from the water zone and automatically lubricated every time the hydrant is operated. Parts cannot corrode. Packing cannot dry out. Continuous, perfect working order is a certainty.



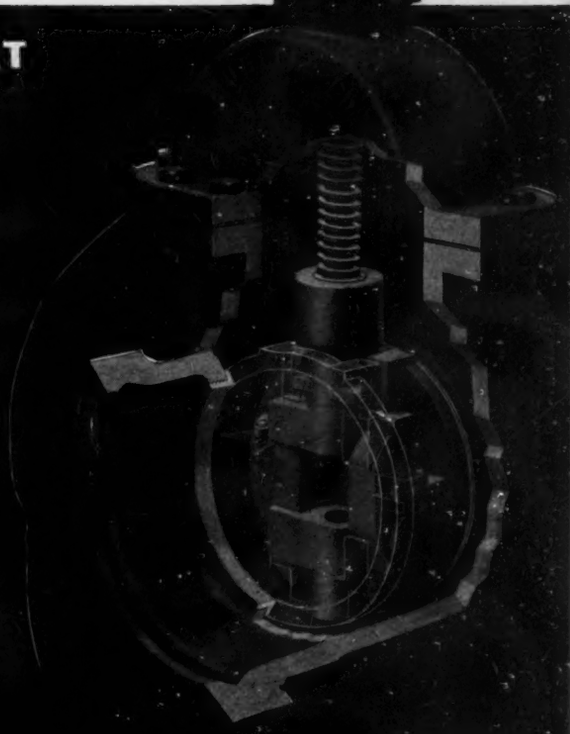
THE SAFETY FLANGE

When collision occurs, only the safety-flange breaks and both top and bottom sections remain undamaged. Within 30 minutes one man can restore the hydrant to original condition for about $5, without digging or water cut-off.

SECTIONAL VIEW . . . . ILLUSTRATES THE MANY ADVANCED FEATURES

Be sure you have complete information about the MUELLER-COLUMBIAN Improved Fire Hydrant and Gate Valve. Detailed explanations and illustrations are ready for you. Write, today.

4 POINT CONTACT GATE VALVE



AN UNDUPLICATED COMBINATION OF FEATURES

1. No Binding of Stem
2. Non-Rusting Packing Bolts and Nuts
3. Easy to Repack
4. No Scraping of Discs on Seats
5. Pressure Equally Distributed on Discs and Seat Rings
6. No Leakage
7. No Sprung Discs
8. No Incrustations
9. Gate Assembly Can't Fall Apart
10. No Side Strains on Stem

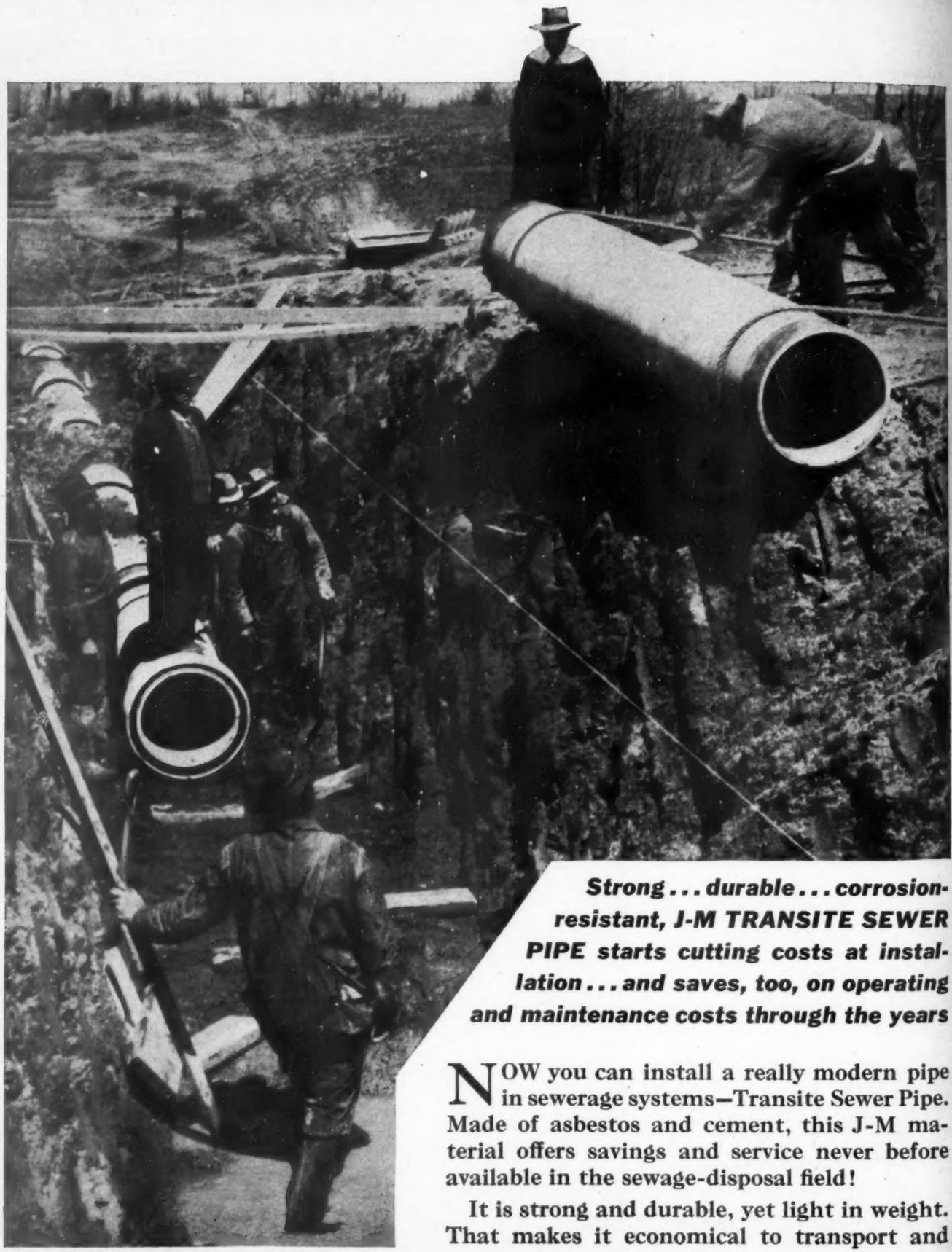
THE WEDGING MECHANISM WORKS LIKE THIS

When the valve is being closed, the discs move to position opposite the ports. The bottom wedge then comes in contact with a rib in the bottom of the valve, preventing further downward movement. Further movement of the stem causes top and bottom wedges to force side spreaders against corresponding wedges on the discs. The side spreaders act as equalizers between the top and bottom wedges, transferring force from the wedges equally to four points around the edge of each disc. In opening, the stem lifts the top wedge nut away from the side spreaders, removing pressure between discs before they begin to rise, preventing scraping and any possibility of breaking seat rings or scoring the valve stem.

MUELLER CO.

CHATTANOOGA, TENNESSEE

The Last Word in



Strong . . . durable . . . corrosion-resistant, J-M TRANSITE SEWER PIPE starts cutting costs at installation . . . and saves, too, on operating and maintenance costs through the years

NOW you can install a really modern pipe in sewerage systems—Transite Sewer Pipe. Made of asbestos and cement, this J-M material offers savings and service never before available in the sewage-disposal field!

It is strong and durable, yet light in weight. That makes it economical to transport and

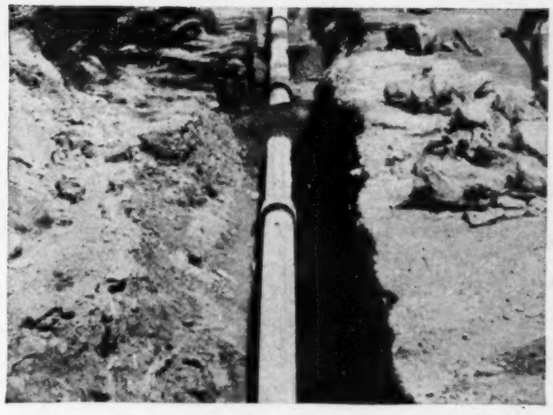
Sewer Pipe Efficiency

(Above) **PRACTICALLY MAINTENANCE-FREE.** Asbestos-cement in composition, Transite Sewer Pipe is exceptionally durable and resistant to both internal and external corrosion. That means maintenance is held to a minimum year after year.

(Left) **EASILY HANDLED.** These men are finding installation an easy affair with Transite Sewer Pipe. For Transite is strong, tough, and light in weight—the long 13-foot sections can be handled quickly, easily and economically.

(Right) **FEWER JOINTS.** Made in 13-foot lengths, Transite Sewer Pipe reduces the number of joints needed, hence still further reducing installation costs. And the long lengths make laying to exact grades, on collection mains, an easier and more certain job.

(Above) **ON FORCE MAINS, TOO,** the long lengths of Transite Sewer Pipe reduce installation costs. Unskilled crews lay it quickly and easily. And the Simplex Couplings used on force mains assure rapid assembly and an absolutely bottle-tight joint.



handle. The 13-foot sections mean fewer joints at installation, saving money at the start. Moreover, these long lengths enable you to lay the pipe to exact grades with greater speed and accuracy.

Once installation is completed, maintenance expenses are practically eliminated. Transite's structure is solid and uniform, and its asbestos-cement composition assures high resistance to both internal and external corrosion.

You should have complete details on this modern sewer pipe. For full information, write Johns-Manville, 22 E. 40th St., New York, N. Y.

JOHNS-MANVILLE

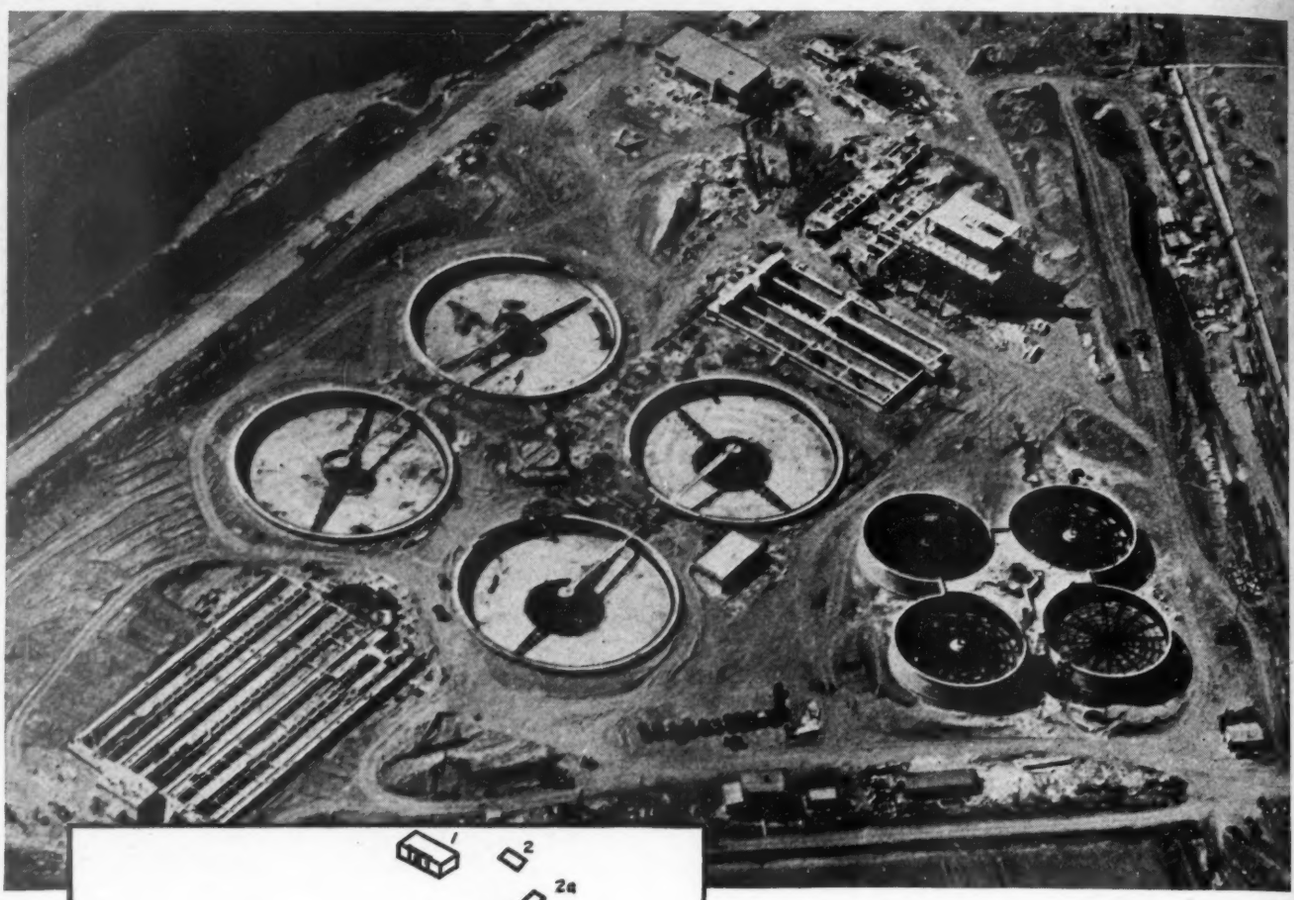
JM PRODUCTS

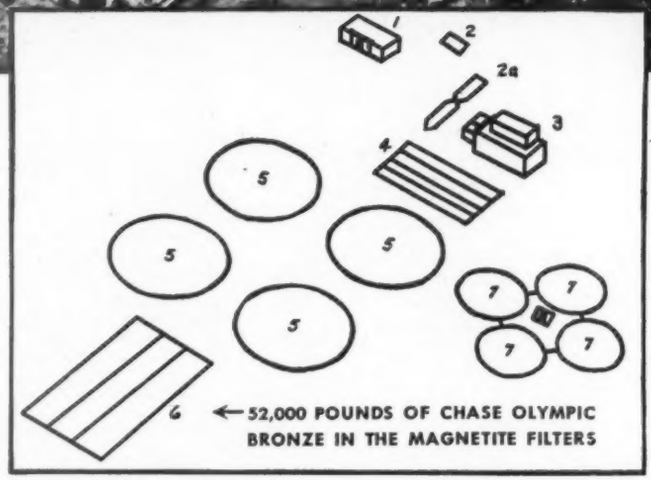
JOHNS-MANVILLE

Transite Sewer Pipe

AN ASBESTOS PRODUCT

And in Denver, **CHASE** Olympic Bronze





KEY TO AERIAL PICTURE—
DENVER, COLORADO PLANT

1. Administration Bldg.
2. Screen House
2a. Grit Basins
3. Chemical House and Iron Chloride Generator
4. Mixing Chamber and Flocculator
5. Clarifiers
6. Magnetite Filters
7. Digesters and Sludge Control House

Chase Olympic Bronze selected for Denver's new sewage treatment plant

• • •

TOUGH . . . CORROSION RESISTANT . . . EASY-TO-WELD

Denver's modern Sewage Disposal Plant is being built to *last*. No chances are being taken on breakdowns caused by rust or corrosion. Its new Magnetite filters, manufactured by Filtration Equipment Corporation, are equipped with *corrosion-resistant* cleaning boxes—52,000 pounds of Chase Olympic Bronze have gone into the construction of the Magnetite filters in the form of wire screens, sheets, plates, castings, bolts and nuts.

Chase Metallurgists will be glad to contribute their specialized knowledge to *your* plans for modern sewage treatment works of *any* size. If you're planning for the future—consult Chase.

CHASE Waterbury

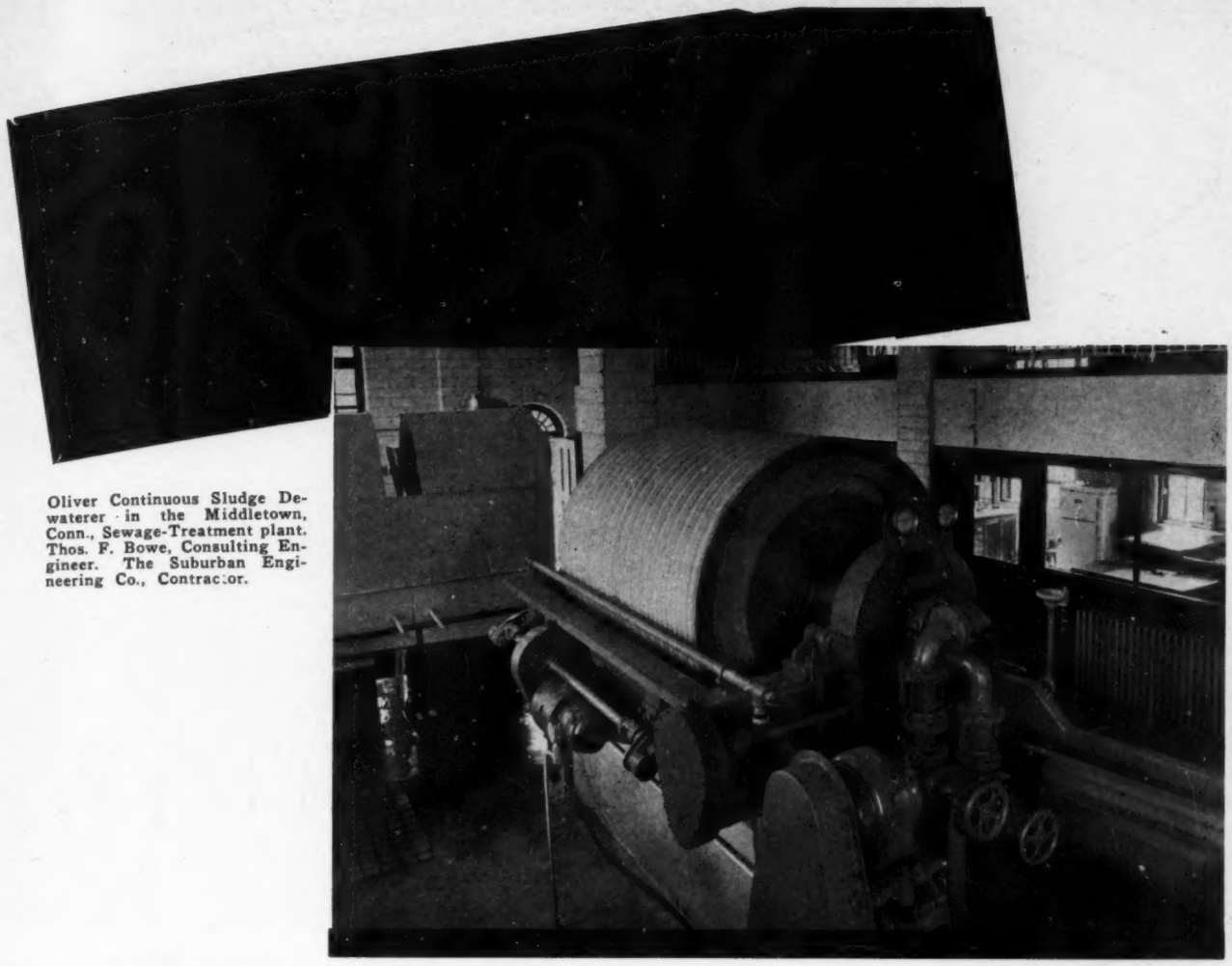
CHASE OLYMPIC BRONZE

CHASE BRASS & COPPER CO.

—Incorporated—

Subsidiary of Kennecott Copper Corporation

Connecticut



Oliver Continuous Sludge Dewaterer in the Middletown, Conn., Sewage-Treatment plant. Thos. F. Bowe, Consulting Engineer. The Suburban Engineering Co., Contractor.

OLIVER SLUDGE DEWATERERS *are Backed by Experience . . .*

City officials, consulting engineers and contractors realize that experience means definite savings in operation and construction of sewage plants.

Experience means knowledge. Knowledge means assurance of the best method for handling the sludge in your proposed sewage-treatment plant and of the most suitable dewaterer.

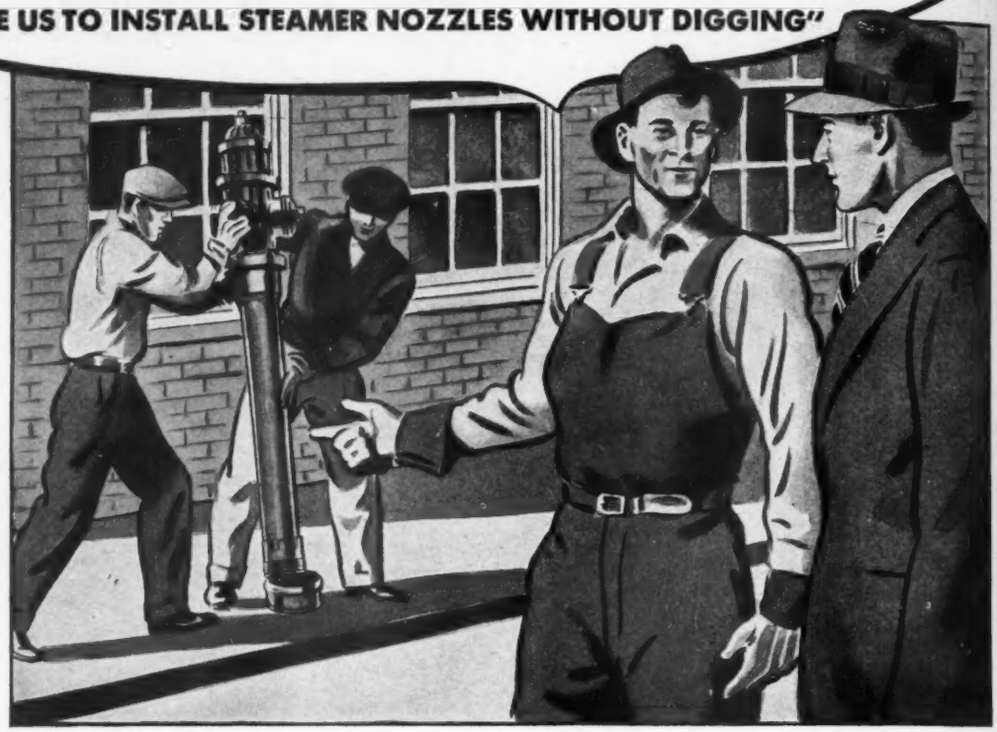
Oliver United Engineers not only pioneered mechanical dewatering of sewage sludges but kept up the leadership in research and test work—constantly improving operations, cutting costs and broadening the application of mechanical sludge dewatering. This, we believe, was the principal reason why the cities listed above selected Oliver United Sludge Dewaterers.

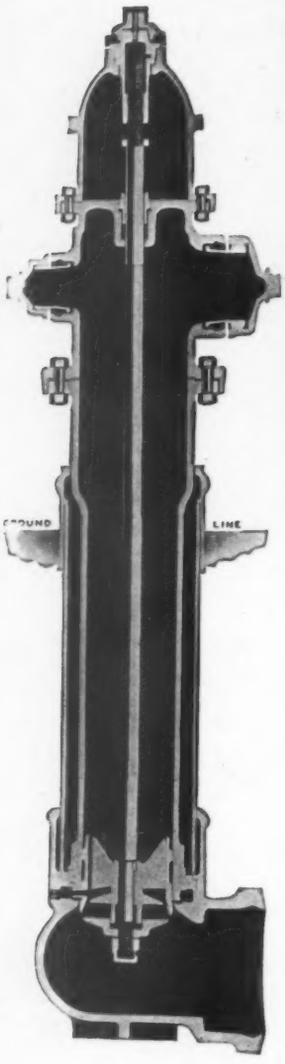
OLIVER UNITED FILTERS INC.

"NOW THAT WE HAVE A NEW PUMPING ENGINE, OUR

Mathews Hydrants

ENABLE US TO INSTALL STEAMER NOZZLES WITHOUT DIGGING"





"THE town's started to grow again. Industries coming in, and taller buildings going up. So we had to have steamer nozzles in the center of town. Lucky for us we have Mathews Hydrants. We're just unscrewing the old barrels complete and sending them out to the new street extensions. Mathews barrels with steamer nozzles are replacing them here in the center of town. It saves digging up city streets. It keeps fire protection uninterrupted."

Specify Mathews Hydrants. Once planted, you'll never dig again.

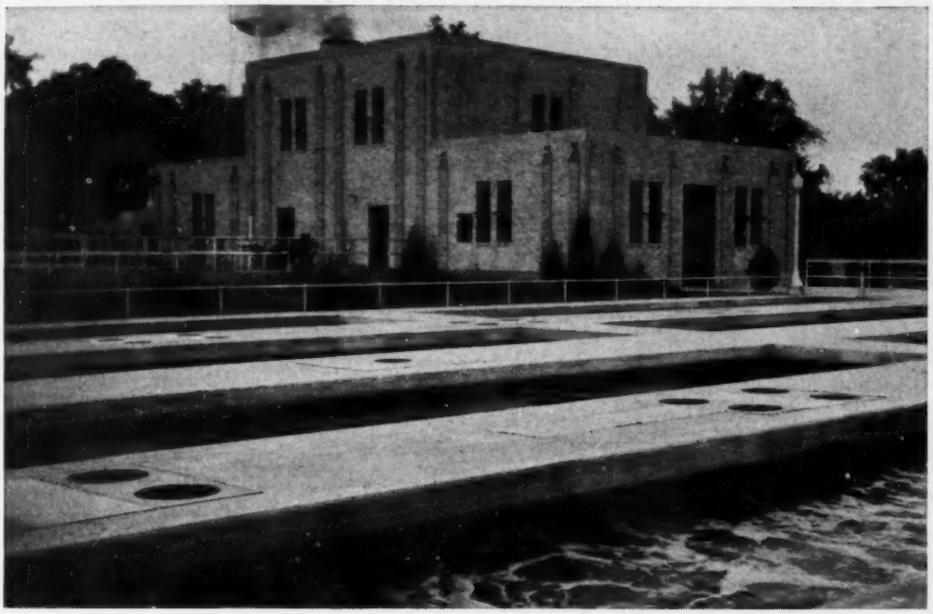
Note that the entire barrel can be unscrewed and lifted out thru the protection case. Or you can take it apart at the swivel joint and put on a new head with steamer nozzles, using all other parts again.

R. D. WOOD CO.
400 Chestnut St., Philadelphia, Pa.

manufacturers of SAND-SPUN PIPE which is centrifugally cast in sand molds, and R. D. Wood heavy-duty gate valves for water works.

Mathews Hydrants
BUILT FOR EMERGENCIES

FORCEFUL FACTS ON SEWAGE AERATION BY AIR DIFFUSION—No. 14



AERATION BY AIR DIFFUSION
is the lowest cost biological treatment

● Aeration by air diffusion has proved many times to be the most economical secondary treatment. This fact is based on comparing the over-all capitalized cost per pound of B. O. D. removed, which is the fairest yardstick. It is the most economical method whether complete activated sludge treatment is practiced, or merely bio-flocculation for semi-complete reduction of B. O. D. and removal of suspended solids. Considering structure and equipment cost per MGD capacity, air diffusion cannot be beaten. In both activated sludge or bio-flocculation treatment you also get the economy and advantage of a nuisance-free plant. If digestor gas is utilized for engines, a still further reduction in operating cost is effected. When considering aeration processes, specify Aloxite Brand Diffusers. More and more cities are using them. They give the greatest efficiency and long-term satisfaction. Ask for our competent service on any air diffusion problems.

POROUS CARBORUNDUM REG. U. S. PAT. OFF. BRAND PRODUCTS

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

REG. U. S. PAT. OFF.

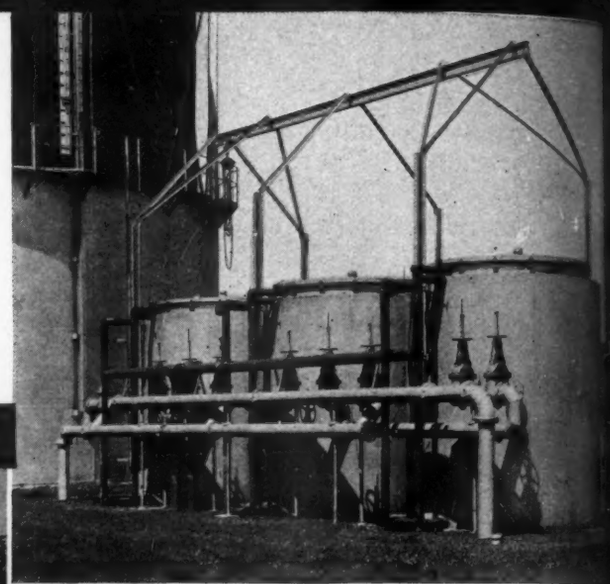
Sales Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids

(Carborundum and Aloxite are registered trade-marks of The Carborundum Company)

KOPPERS

KOPPERS WESTERN LINE FEATURES ULTRA-MODERN EQUIPMENT

The KOPPERS WESTERN line of equipment for the sewerage field is designed by men thoroughly grounded in the principles and problems involved, and in line with today's demand for maximum economy, as well as efficiency. Of special interest is the gas purifying equipment, which has permitted many municipalities to utilize sewage gas for operating internal combustion engines, to heat public buildings, and for other uses.



A KOPPERS WESTERN Purifier installation at the Greater Peoria Sanitary and Sewage Disposal District plant, Peoria, Ill. Each of the three purifiers is 12′ diameter x 12′ deep with circle series gas connections, slide boards, heating coils, and cover hoist.

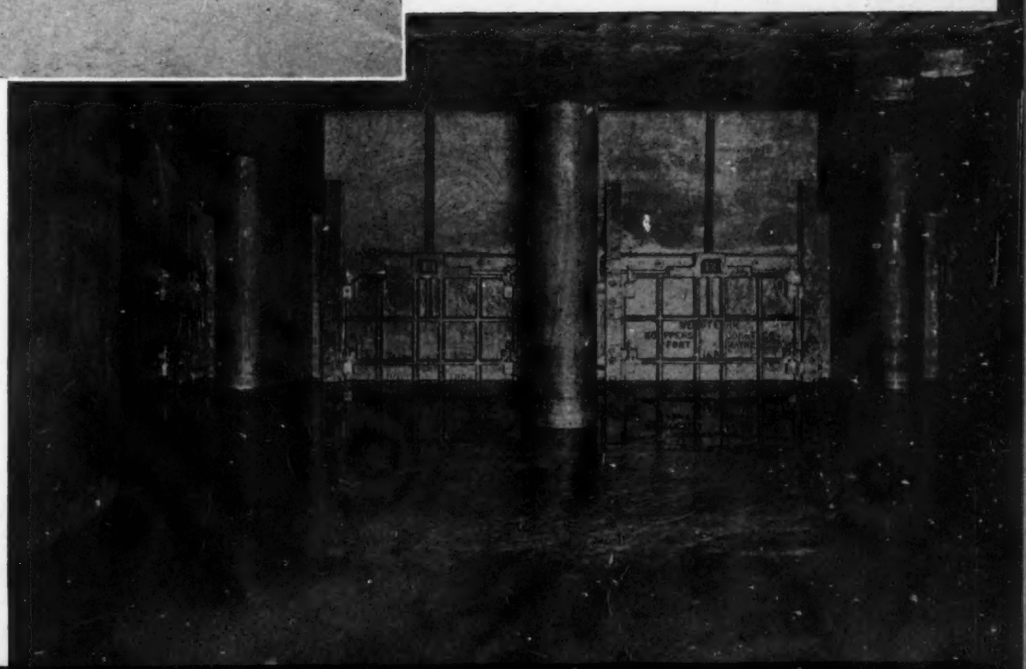
Another purifier installation, with all equipment concealed underground. This is at the disposal plant of the City of Battle Creek, Michigan.

WESTERN

Behind the grill may be seen two 96" x 60" Motor-Operated Sluice Gates, provided by Western Gas Division for the interceptor sewers.

The Minneapolis-St. Paul Sanitary District is justly proud of its new plant . . . This organization is justly proud that its equipment has helped to make the system a model of advanced design. Pictured are some of the Koppers Western Sluice Gates, that permit control and dispatching of the contents of the interceptor sewers. Full details on the complete line of sluice gates, purifiers, valves, and other Koppers Western equipment for the sewerage field will be furnished on application.

KOPPERS COMPANY
WESTERN GAS DIVISION
FORT WAYNE, INDIANA



A group of 42" x 42" motor-opetated sluice gates in use in the interceptor sewers of the Minneapolis-St. Paul Sanitary District system.

COLUMBIA

LIQUID CHLORINE

In Single and Multiple Unit Tank Cars,

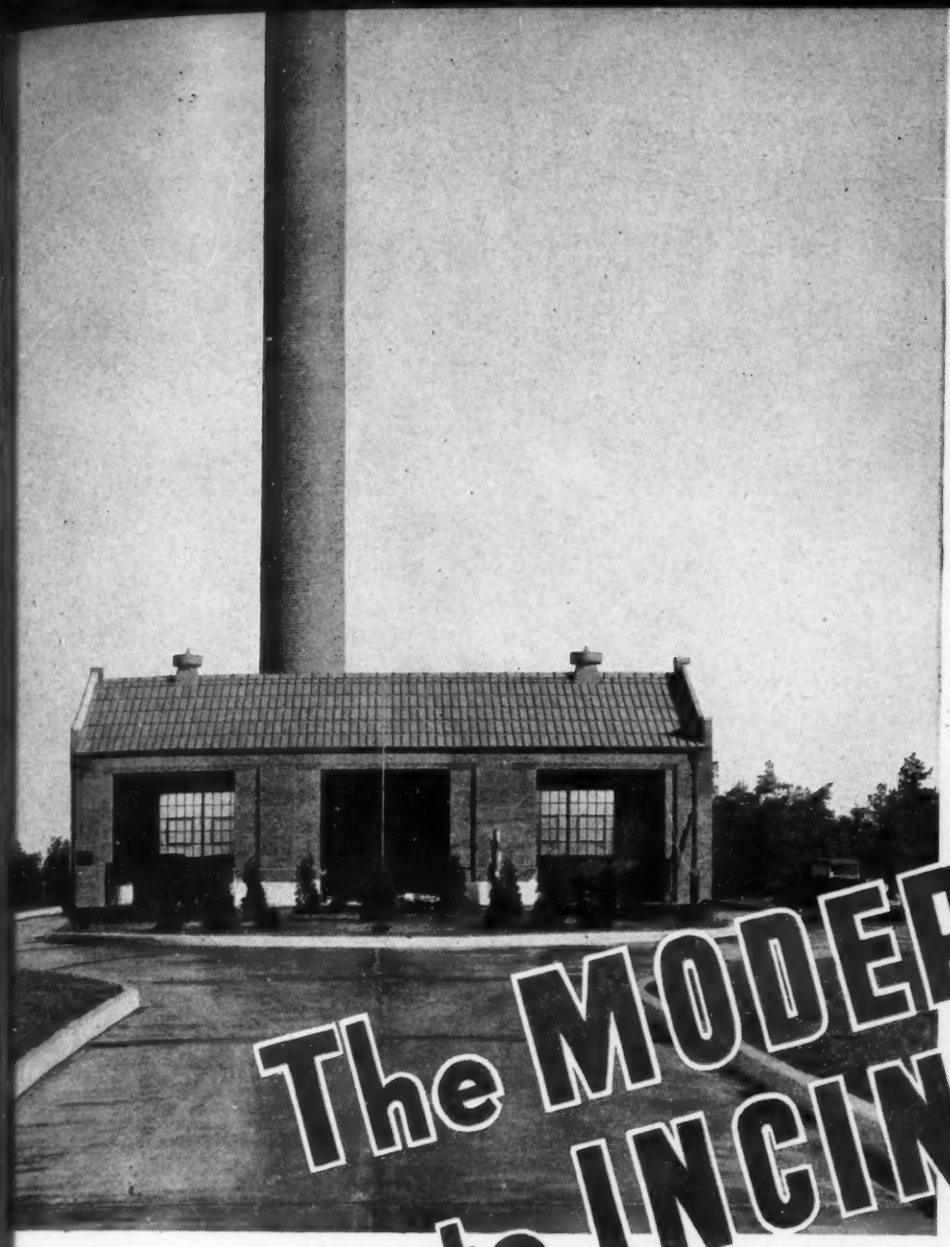
Also 100 and 150 lb. Cylinders

TRADE MARK REG.

THE COLUMBIA ALKALI CORPORATION

BARBERTON • OHIO

NEW YORK BOSTON MINNEAPOLIS
CHICAGO CLEVELAND CINCINNATI
ST LOUIS PITTSBURGH



The MODERN way is to INCINERATE and to have P·D M build the plant

Alert municipalities are proving that *thoroug incineration* is the cleanest, easiest and chea est way to dispose of burnable refuse. Ol cumbersome and unsanitary methods of garbag dumping are not only objectionable from th hygienic standpoint, but actually more costl

Efficient incinerators, built the P·DM way, a a source of community pride and profit. Pitt burgh-Des Moines Incinerating Plants create n smoke or odor nuisance, are simple in co struction and extremely economical to o erate. Maintenance expense is negligibl

Investigate this modern solution to a ancient problem. *Write to P·DM*—d signers and builders of the world's large incinerating furnace, and plants gre and small in communities everywher

PITTSBURGH · DES MOINES STEEL CO.

PITTSBURGH, PA. 3418 NEVILLE ISLAND—DES MOINES, IA. 919 TUTTLE ST.

NEW YORK, ROOM 918-99, 270 BROADWAY . . . CHICAGO, 1222 FIRST NATIONAL BANK BUILDING

DALLAS, 1223 PRAETORIAN BUILDING SAN FRANCISCO, 625 RIALTO BUILDING

RENTAL BONDS . . financed this PIPE-IN-TUNNEL project

Placing 36-in. reinforced concrete pipe combined sewer in tunnel, Oak Park, Ill. Showing pipe handling equipment. Note box type timbering—and good alignment of pipe

Each section of pipe carefully backfilled with foundation concrete

THE new concrete sewerage system in Oak Park, Ill., includes a 3-mile semi-horseshoe-shaped outfall ranging in section from 41 by 67 in. to 88 by 110 in. Also 6½ miles of concrete pipe interceptors and laterals, 24 to 42 in. in diameter.

Two facts make this program doubly interesting:

1. *Rental bonds solved financing.* The Village's share of the cost was financed by a $1,100,000 bond issue to be retired over a 20-year period by collections from property owners on a water consumption basis. Average cost to water users will be only about $8 per year each. The bonds found a ready market at a time when municipal financing was none too easy.

2. *Pipe laid in tunnel.* Of the 39,300 ft. of pipe, 19,230 ft. was built *in tunnel*, open cuts being used only where cut was less than 20 ft. deep to invert. Tunneling saved money over open cut construction, even for smaller size pipe, because there was less excavated material to dispose of during construction and because pavement cuts were avoided. The contractors, Michael Pontarelli, Inc., and M. J. Boyle, are enthusiastic over the ease, simplicity and economy of building concrete pipe lines by this method.

This work was completed under the direction of C. A. Walls, commissioner of public works, with village engineer William Thomas in charge.

Another type of timbering used in Oak Park

American Concrete Pipe Association bulletin No. 11, "*Constructing Concrete Pipe Sewers in Tunnel*," will give you helpful facts on this subject. Includes advanced safety specifications of Wisconsin Industrial Commission, with numerous sketches and photographs of recent jobs. Sent free on request.

PORTLAND CEMENT ASSOCIATION

Dept. 10-29, 33 W. Grand Ave., Chicago, Illinois

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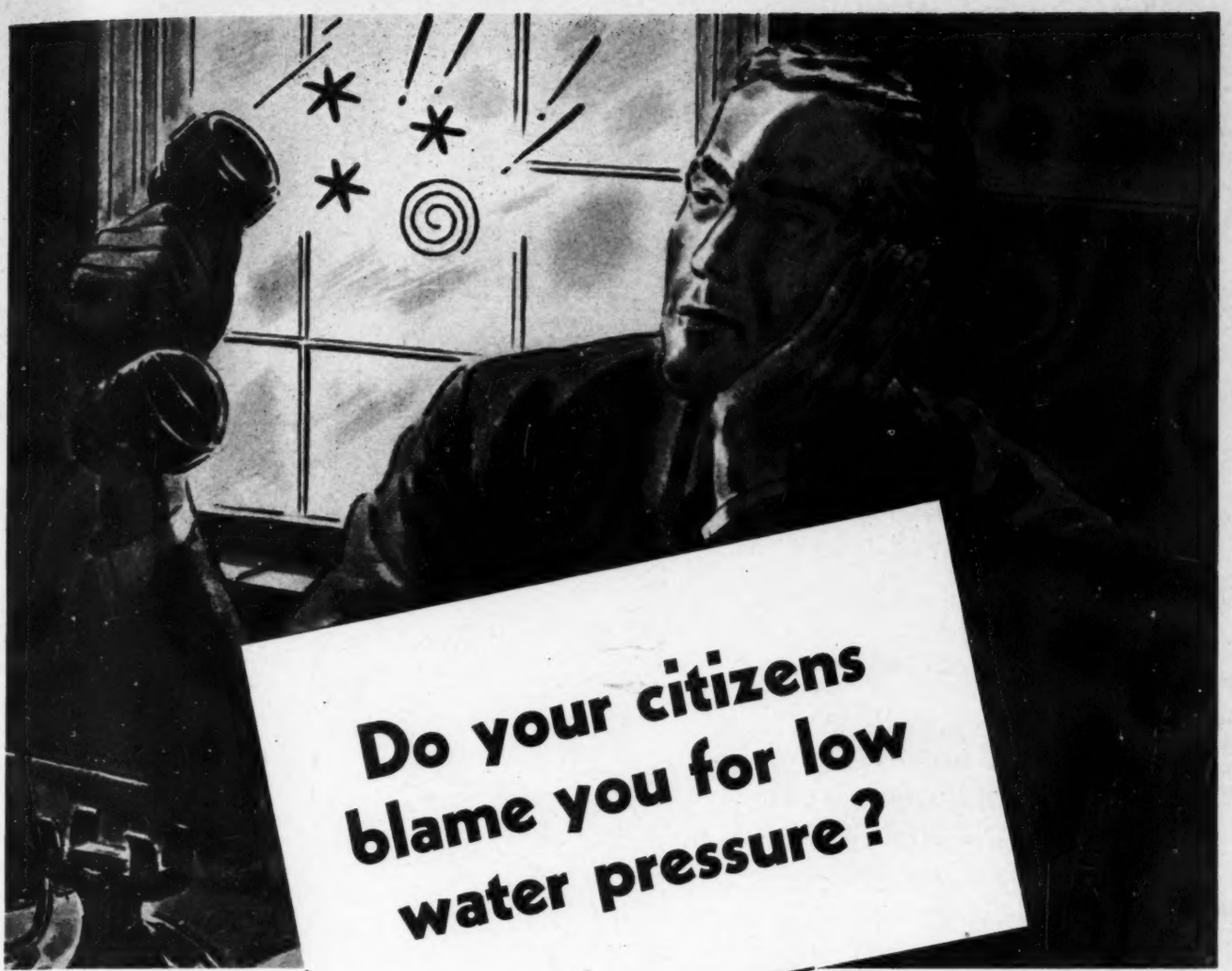

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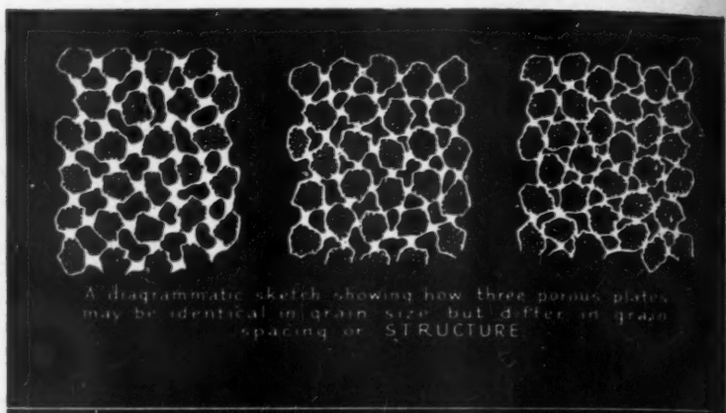
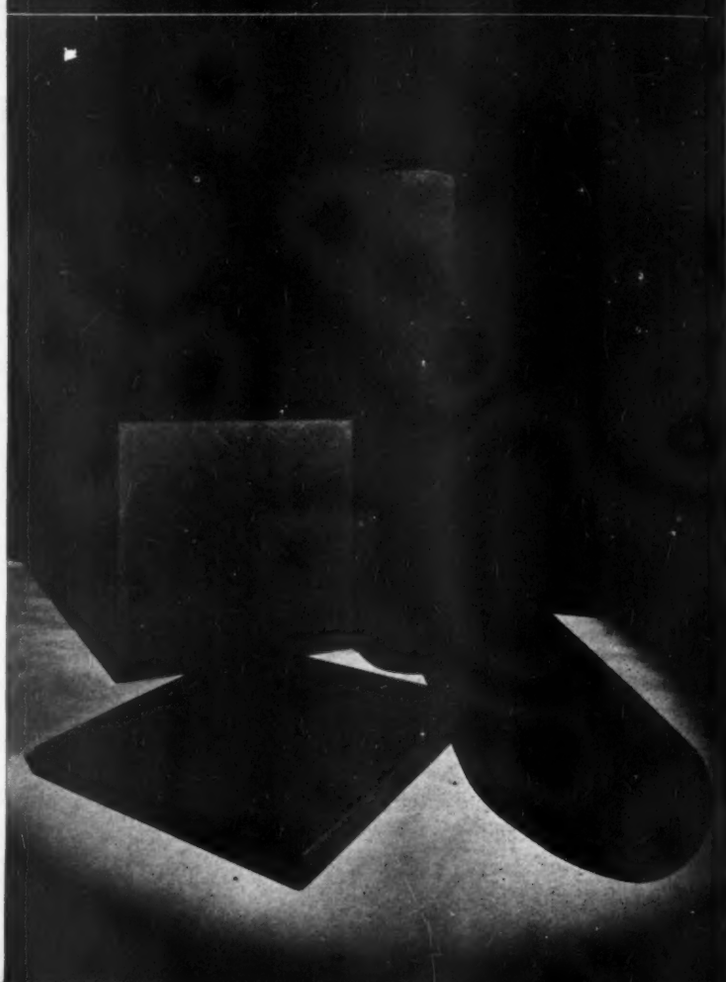


A diagrammatic sketch showing how three porous plates may be identical in grain size but differ in grain spacing or STRUCTURE



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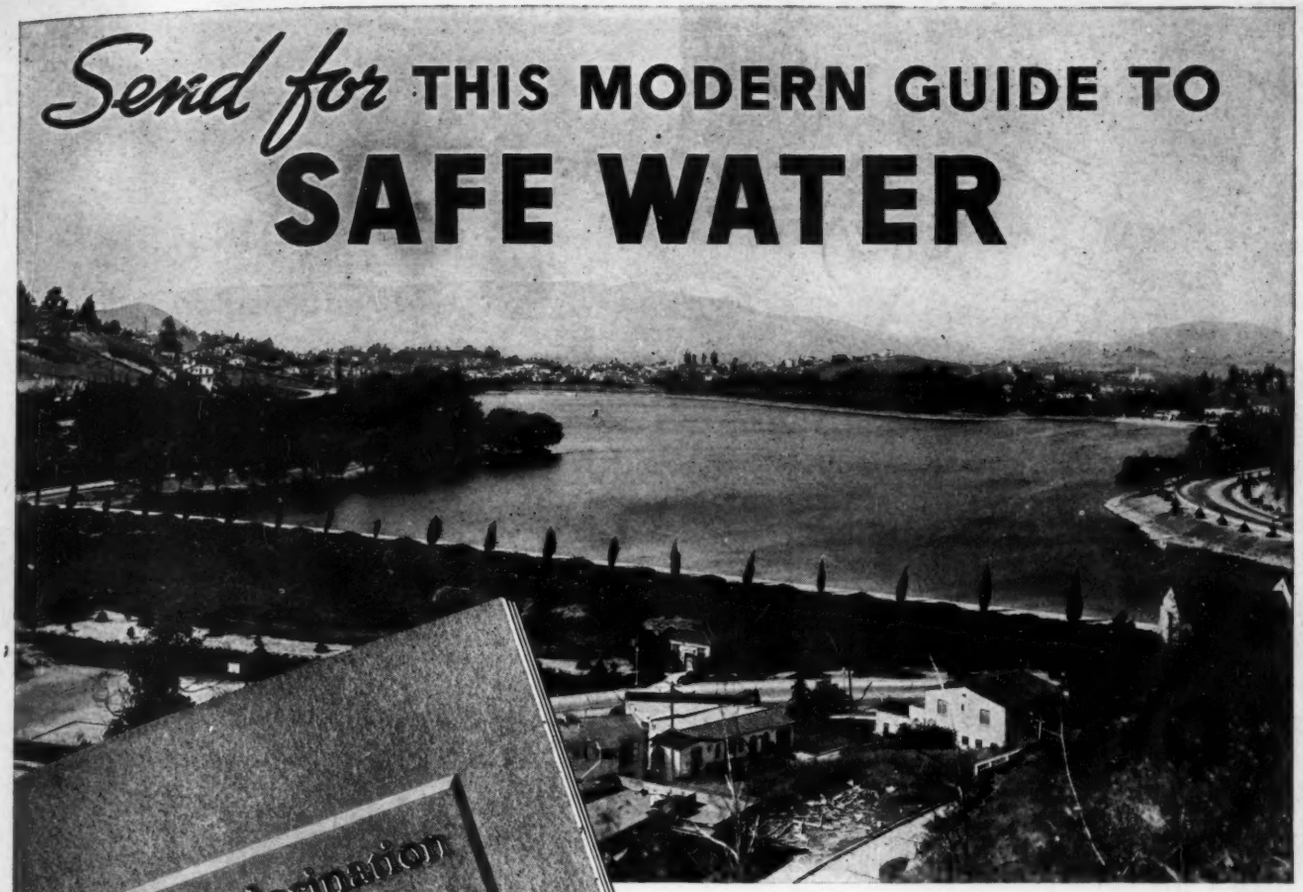

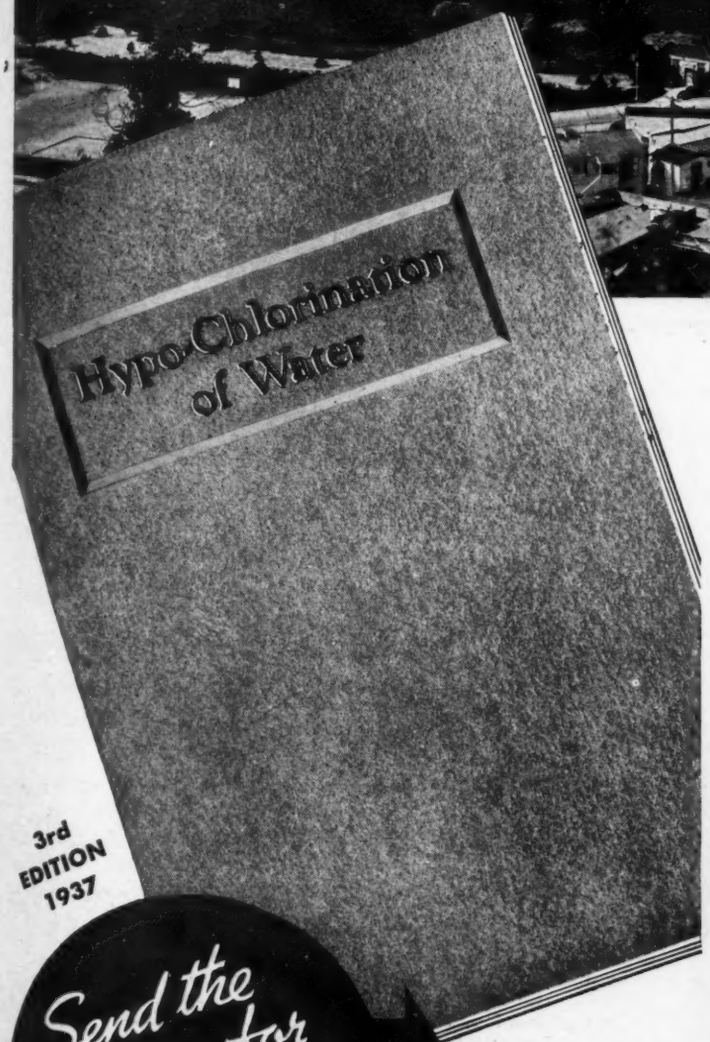

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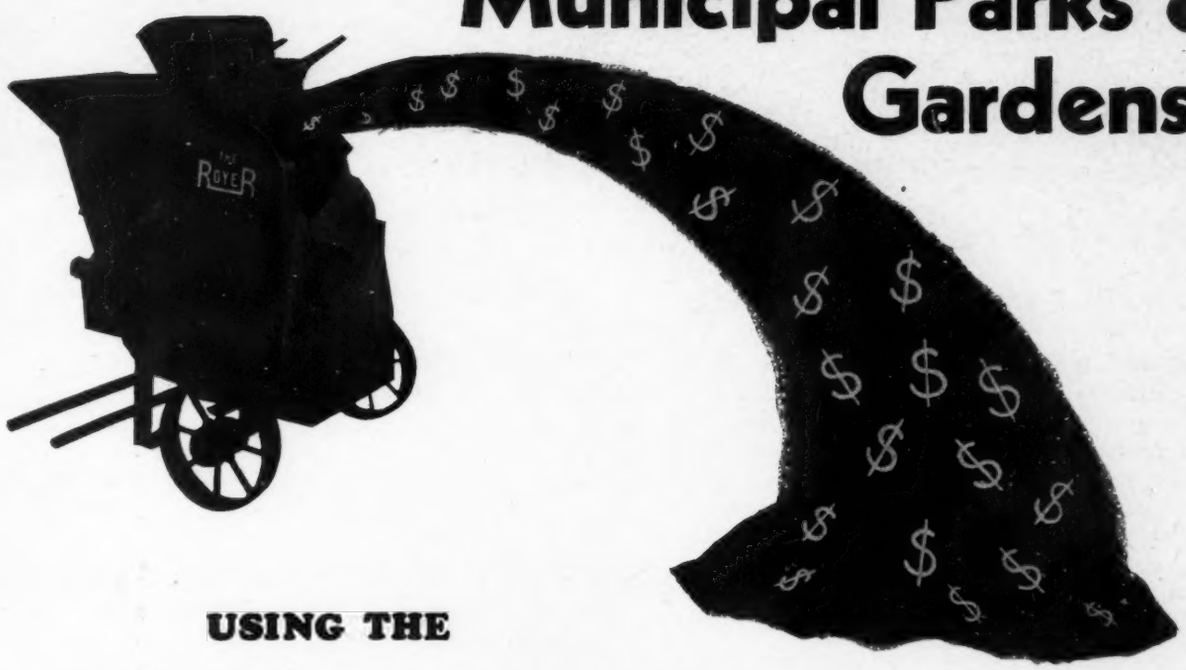

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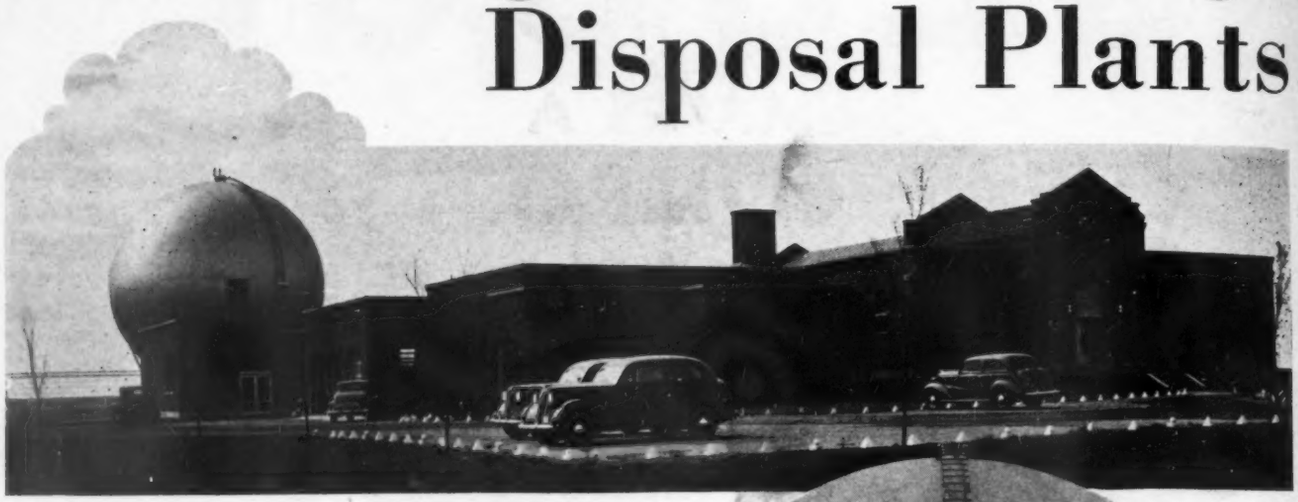


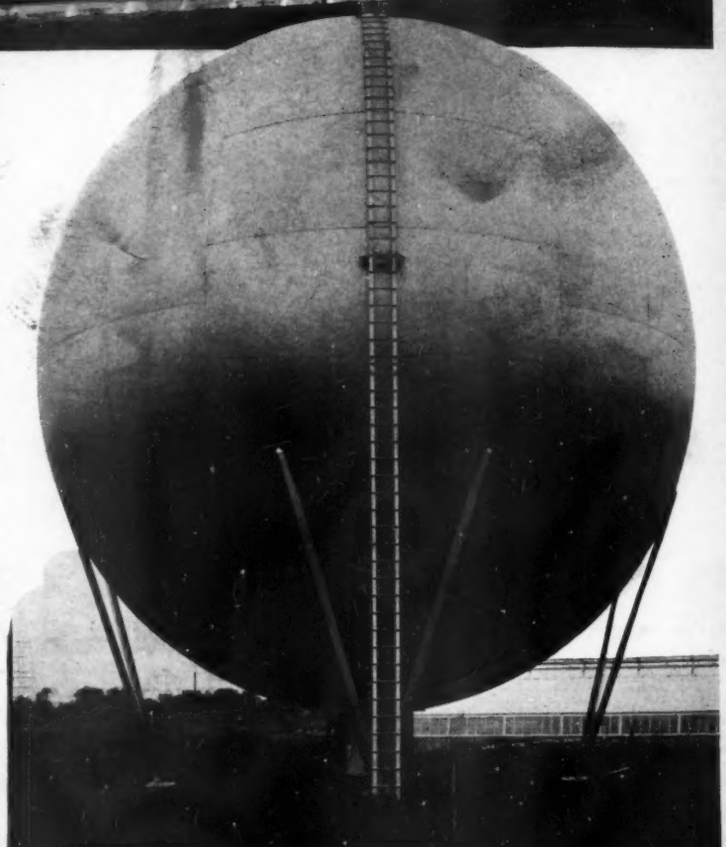
Cuts Operating Costs at Green Bay, Wisc.

ENGINEERS for the city of Green Bay, Wisconsin, were recently confronted with a serious problem. In carrying forward a program for complete metropolitan district sewerage treatment, poor soil conditions were encountered which made construction of a deep system necessary. With a maximum head of 50 ft. to pump against, pumping costs were abnormally—though unavoidably—high.

The problem was solved—as it has been in several towns recently—by utilizing sludge gas. Investigation showed that engines could be installed that would run on the gas and produce power for pumping—providing the gas supply could be made dependable.

The gas supply was made dependable by installing a 50 ft. Hortonsphere to serve as a balancing reservoir in much the same manner as Horton elevated tanks serve water supply systems. The size of the Hortonsphere was determined by calculating the power necessary to operate the plant during shut-down periods and to carry the peak load at times of excessive pumping. At the present time the plant is producing a surplus of 5,000 cu. ft. of gas per day which is placed in storage for this purpose.

For complete information about Hortonsphere for gas storage service, address our nearest office. Quotations on request.



THE HORTONSPHERE

This 50 ft. dia. Hortonsphere is located at Green Bay, Wisc. It holds sludge gas at a pressure of from 10 to 30 lbs. per sq. in., depending on volume of gas in storage. Above is a general view of the plant.

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WATER WORKS & SEWERAGE

E. S. GILLETTE, Publisher — L. H. ENSLOW, Editor

ARTICLES AND AUTHORS Scheduled for Future Issues

"The Relation of the Municipality to Its Water Supply"—is a timely and meritorious contribution from William C. Emigh, City Engineer and Superintendent of Water and Sewages at Coatesville, Pa.

In his opening paragraph the author shoots direct at the bull's-eye when he states—"It can hardly be denied that the weakness of engineers, and water works and sewerage men as a group, has more often been manifest in their failure to place principles and practice before the public in **understandable and convincing** manner, than in any deficiency in technical knowledge and ability. . . . Not until technical men sell themselves and their profession to the public, will they receive the recognition which they deserve and inwardly desire."

Mr. Emigh's paper will give many a reader the inspiration lacking in the matter of talking "shop" with the public. Here is a paper which will serve as a "tailor-made" speech for the water works manager, superintendent or chemist, who has the opportunity of addressing the public, or the Rotary Club, or the like, on "Water Supply and Its Relation to the Municipality." Mr. Emigh's paper can be used to excellent advantage as the basis of a printed booklet for distribution. Better still, as "copy" for the Editor of the local newspaper for a series of articles. Watch for it—it is too valuable to miss.

"What Cost Leaking Manholes?"—constitutes an account by **A. M. Rawn***, Assistant Chief Engineer, Los Angeles County Sanitation Districts, of findings in a survey and study which revealed good and bad features of manhole cover design. In respect to leaking tops, grit entry and storm-water surcharging of sanitary sewers, the author reveals data which will prove surprising to most designing and operating engineers. Mr. Rawn's findings show the need of giving more attention to specifications covering manhole castings and cover design, than has been commonly considered warranted. (*Associate Editor, Water Works & Sewerage.)

"Some Plant Operating Kinks"—are revealed in an article by A. R. Todd, Chemist and Filtration Supt. at Wheeling, W. Va. Of especial interest is the method employed in cleaning filter sand (in place) by an economical scheme of "salting the slime coated sand in the beds. Of importance is the method of preventing tastes, which involves coagulation in acid range with copperas, assisted by chlorine, to oxidize the organic taste producing products. Mr. Todd reveals the effect of pH. on taste production and, also, the Wheeling method of circumventing interference with the residual chlorine tests, such as is created by manganese. The method of "catalytic—coagulation" is worthy of the reader's attention wherever taste production is a problem.

Coagulation—Aided by Silicates"—is the subject of the fourth of a series of articles by John R. Baylis, of Chicago, on the silicate phenomena, discovered and being studied by him. [We regret that Mr. Baylis' fourth installment could not be printed in this issue, as planned. —Ed.]

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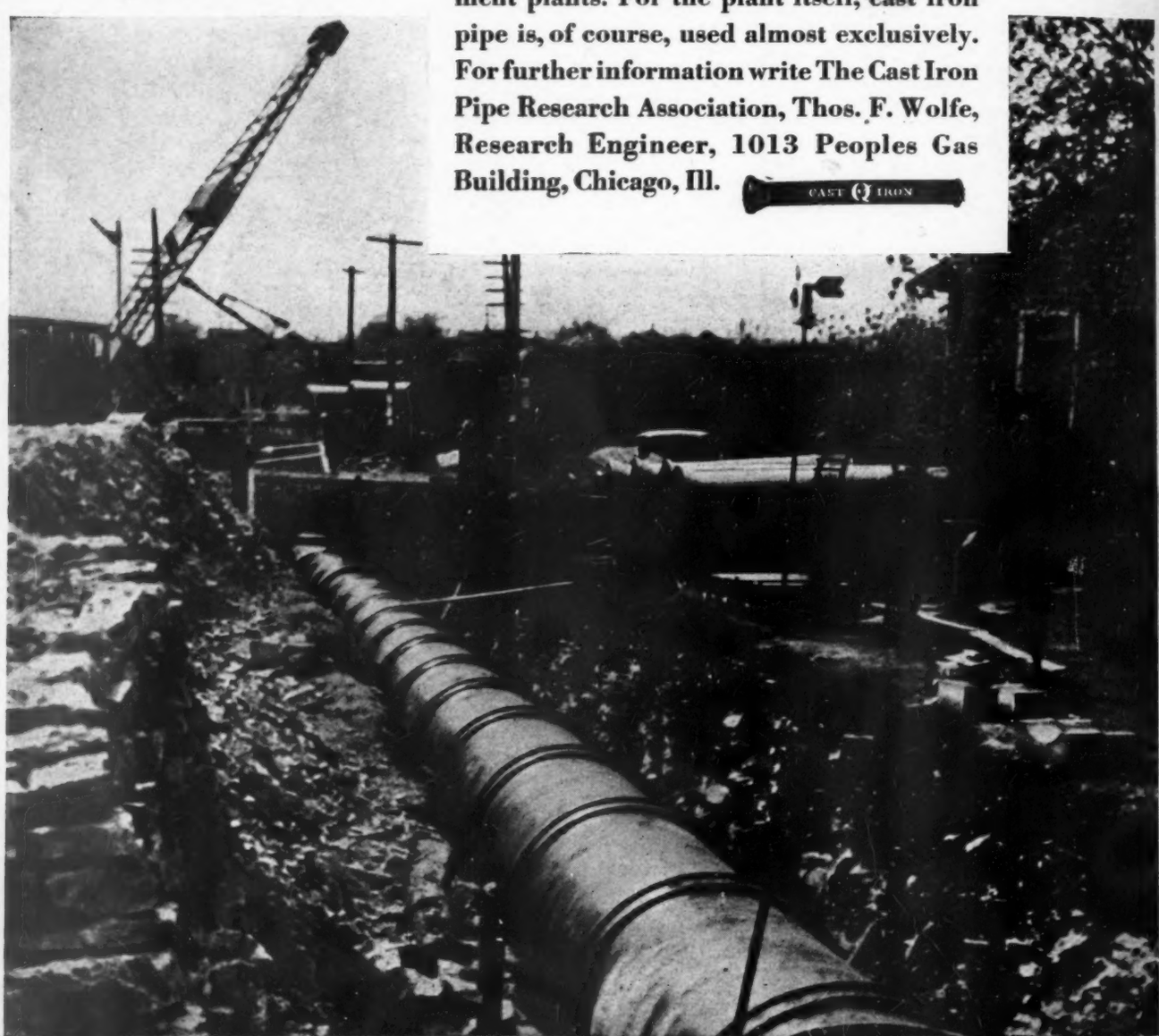


Installing 60" cast iron pipe for sanitary sewer at Joliet, Ill.

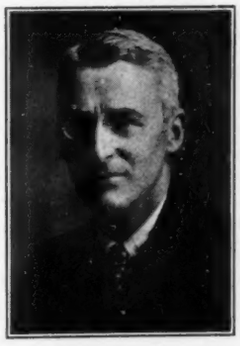
CAST IRON PIPE

WATER WORKS AND SEWERAGE
A GILLETTE PUBLICATION
VOL. 84 OCTOBER, 1937 No. 10

AN OLD WATER SYSTEM WITH NEW IDEAS

By RICHARD F. WAGNER
Director of Public Works
Lynchburg, Virginia

LYNCHBURG, in Old Virginia, among many other things, is proud of the fact that its municipally owned water system is one of the oldest in the United States, dating back to 1829.



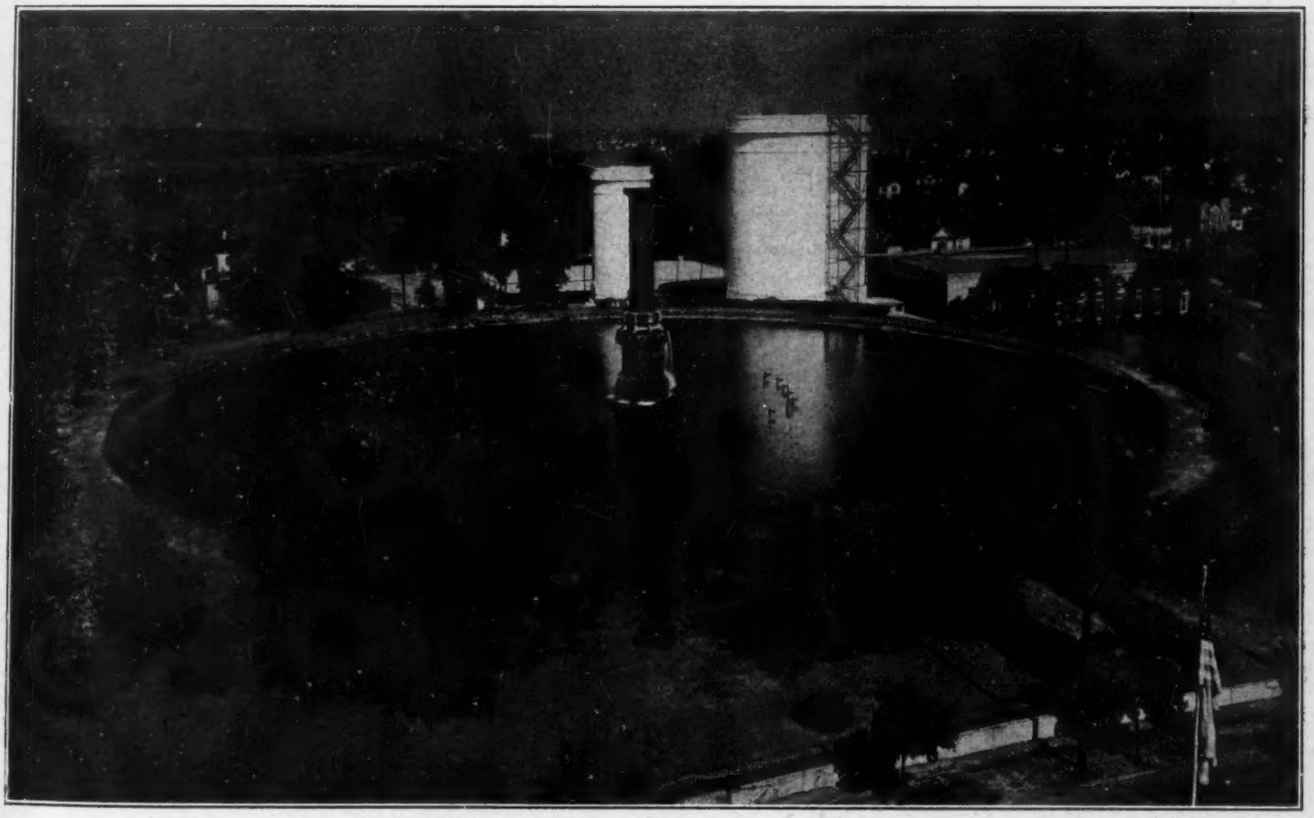
The Author

One distinction that Lynchburg has is that of possessing and still operating the second oldest Cast Iron water-main in America. This main is seven inches in diameter and recent inspection revealed the fact that it is virtually in as good condition as when placed in the ground more than 108 years ago.

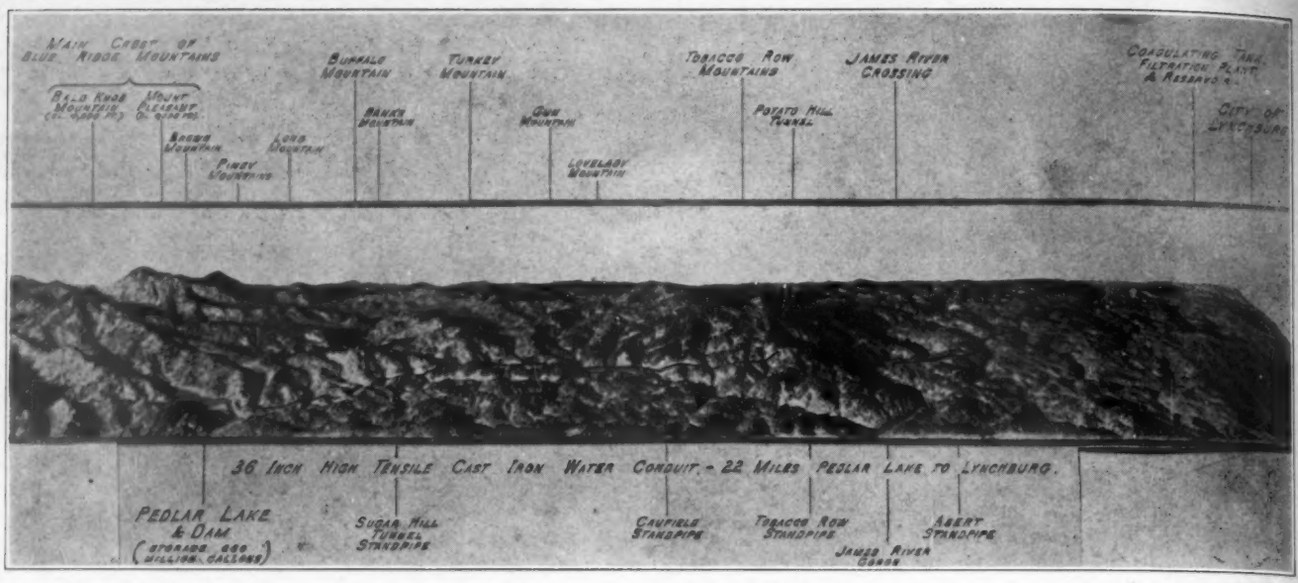
History

Prior to 1829, water was supplied by private interests from springs and distributed through bored logs. The first municipal system used the James River as a source, the supply being pumped to a reservoir 220 feet above the level of the river, which lift for that time and day was by no means a feat without great import and widespread interest to water supply engineers. An old *Chronicle* relates that most of the Lynchburgers were sceptical as to the ability of the newly developed pump to lift water to such heights. And, on the day it was to be tested, the leaders responsible for the project were, in fact, advised to leave town. It is also recorded, however, that when water gushed forth before the throng collected at the reservoir the crowd "went wild with fervor and wonder."

The historic James continued to furnish a more or



Lynchburg's Historic College Hill Reservoir and Filter Plant of 1918. *(The 70 Ft. Deep Coagulation Tank with "Aer-O-Mix" Unit in the Top Appears in Center—Wash Tank on Left.)*



A Section of a Relief Model of the Terrain Traversed by Lynchburg's 22 Mile Supply Main. (Presented to the City by the Lynchburg Foundry Co.)

less acceptable water until the turn of the century when waste products, discharged into the stream by industrial plants above, created a condition which made the selection of another supply imperative.

Surveys of several streams tributary to the James, whose watersheds were sparsely settled, resulted in the selection of Pedlar River, a mountain stream of Amherst County, as the new source. Construction of a dam and supply line was undertaken in 1904 and completed during 1907.

Original Gravity Supply Main of Wood Stave Pipe

The terrain traversed by the line is for the most part steep and rough. The line was constructed largely of continuous California Red-Wood stave pipe, 30 inches in diameter and twenty-one miles long. Short sections of Lock-Bar steel pipe were installed where the head exceeded 200 feet, while cast iron pipe was used at river crossings. The gradient was one foot per thousand feet, resulting in a delivery of 8 million gallons daily.

The dam, 425 feet long and 50 feet high, is of the gravity type, built of concrete, impounding 400 million gallons. The lake is a gem adorning the breast of the Blue-Ridge, surrounded by forests of primeval aspect.

Our Troubles Begin

The new supply was certainly a boon to the people of Lynchburg for a number of years until algae growths made their appearance. In attempting to control these organisms with copper-sulphate, great numbers of fish were killed and almost overnight the much toasted water assumed the characteristics of a "Witch's Broth." I am told that many were the lamentations in those days. Then, too, after the supply line had been in operation about ten years, numerous leaks began to develop, which kept the management on edge constantly. Those sections of the wood pipe, with a porous backfill, decayed more rapidly due to the alternating conditions of moisture and dryness. During one month in 1920 the flow through the line was interrupted on three occasions, for the purpose of making repairs when more than 100 wood staves had to be replaced. Therefore, while the new system in a sense was a blessing, it had also its deficiencies.

Filtration the Next Step

The Public's standards are constantly tending towards more ideal conditions in respect to water supply. Such being evident in Lynchburg, led to the construction of a filtration plant in 1918. Local conditions markedly favored the use of pressure filters in order to continue all of the system upon a gravity supply basis. Twelve units, each of a rated capacity of 500,000 gallons daily, were housed in a brick building of attractive architecture with ample reserve space for future units.

A deep cylindrical coagulating tank and a similar washwater tank, both of reinforced concrete construction completed the lay-out. Concrete was selected for these structures because, on account of war conditions, its use was more economical than steel. Since that time, however, the cost of waterproofing them has more than wiped out the savings effected. The coagulating tank is a structure 70 feet high and 50 feet in diameter with a circular baffle. This deep tank has functioned very satisfactorily. A spray-nozzle aerator was used for 12 years to reduce carbon-dioxide and algae odors during the summer months. This method fo aeration was replaced by a Vogt Aer-O-Mix Unit in 1930, however, in order to eliminate the cost of pumping,

Increased Storage Necessary

Following the drought of 1930, when the City came perilously near to being compelled to drink James River water again, the impounding dam was raised ten feet and strengthened accordingly. Thereby, supply storage was increased by 50 per cent to 600 million gallons.

Sheet Lightning Turns to Thunderstorm

By the year 1921, the increasing number of leaks developing in the wood stave supply line made it apparent that sooner or later certain sections would require replacement. To defray such costs, the City during that year and annually thereafter, set aside from current revenues the sum of $15,000. Beginning in 1927 actual replacement became imperative. Between 1927 and 1933 something over two miles of the original 30-in. pipe were replaced with 36-in. Cast Iron pipe, the work being done with departmental forces during the working season.

Early Participation in the P. W. A. Program Makes New Supply Line Possible

During the Fall of 1933, in order to step up employment of idle labor and for the purpose of accomplishing a major replacement, the City applied for and secured

the approval of the Public Works Administration to replace 9.5 miles of the original conduit with 36-in. Cast Iron pipe. This project was authorized on a Force Account Basis and permission was secured to work labor ten hours per day. (The latter edict was evidently an oversight on somebody's part in Washington and was the source of a considerable amount of investigation from time to time until the job was completed.)

Design of Conduit

The City's engineering staff has always been convinced that, in many instances, unnecessary funds are expended by using pipe of considerably heavier wall thickness than circumstances justify. Especially is this true with supply lines, most of which, if properly designed, should not be subject to any water-hammer to speak of or serious impacts from traffic.

In collaboration with engineers of The Lynchburg Foundry Company, two separate classifications providing for a nominal wall thickness of 0.80 inch and 0.92 inch respectively, were decided upon, the former to be used for heads up to 50 lbs. per sq. inch, the latter for pressures between 50 lbs. per sq. inch and 100 lbs. per sq. inch. Class "B" (A. W. W. A. Specification) pipe was used for heads between 100 lbs. per sq. inch and 130 lbs. per sq. inch; and, Class "C" (A. W. W. A. Specification) pipe for heads above 130 lbs. per sq. inch, the highest pressure on the line being 170 lbs. per sq. inch. Careful consideration was given to those locations where the height of backfill exceeded five feet, in which instances heavier pipe was specified. All pipe was coated only with the usual coal-tar pitch. This seemed ample protection because the water, though soft, was tested by a laboratory of national reputation and found to possess little or no corrosive properties. Special fittings all conformed to A. W. W. A. Standards. The customary air-release valves, blow-offs, and other appurtenances necessary were all of conventional design.

Camp Facilities

Since the average distance of the construction was 17 miles from the City, and since it was essential that citizens of Lynchburg be employed on the project, camp facilities had to be provided. Since such camp had to be mobile, tents were used for housing the men and for mess halls, while a frame building of knock-down construction served as kitchen, storeroom, foreman's mess and recreation-center. Camp was moved on five occasions and required two days for each set-up.

Working Methods

All of the work was performed by Force Account with the exception of the delivery of the pipe on trench site. Excavation and backfilling were all hand-work. The 48,000 feet of trenching involving 51,000 cubic yards of earth and 4,000 cubic yards of rock, drilling was performed with air-drills and blasts were set off by electricity. The pipe, weighing from 3,800 to 6,500 lbs. per 12 foot section, was handled by a Caterpillar Tractor, equipped with a side-boom. In some few unusually steep places (40% to 60%) timber tracks were placed along the bottom of the trench and the pipe tramwayed to its final location from the crest of the hill. Owing to the rough terrain, the excavated material in many instances had to be handled several times.

All but a small percentage of the working crews were secured through the National Employment Service. Each person referred for employment was subjected to a physical examination by the City's physicians and approximately 15 per cent were rejected. As a result practically no time was lost on account of sickness and the output for this class of labor was comparatively high, substantial types of food and ample hours of rest and

An Easy Going Stretch—The New 22 Mile Supply Line of 36 In. Cast Iron Pipe, Lynchburg, Va.

sleep contributing not a little to such results. Two shifts of 110 men each constituted the force, each shift working 30 hours per week. Common labor was paid the usual PWA rate of 45 cents per hour with semi-skilled and skilled labor correspondingly higher.

The following tabulation indicates the efficiency of the labor worked. In this connection, it must be kept in mind that most of the terrain was rough and required rehandling of the material; and, that weather conditions at times were very unfavorable.

Earth Excavation, per cu. yd.....2.78 Man Hours
Rock Excavation, per cu. yd.....5.29 Man Hours
Backfilling, per cu. yd.....0.88 Man Hours
Pipe Laying, per lineal ft.....0.60 Man Hours

Costs

The cost of the project was $556,000 (estimated cost, $600,000), which, carrying a PWA grant of $159,000, created a net cost to the City of $397,000. Twenty-six per cent of the cost was expended in direct labor on the construction site. In the final analysis, the total cost per foot of pipe installed proved to be $11.58.

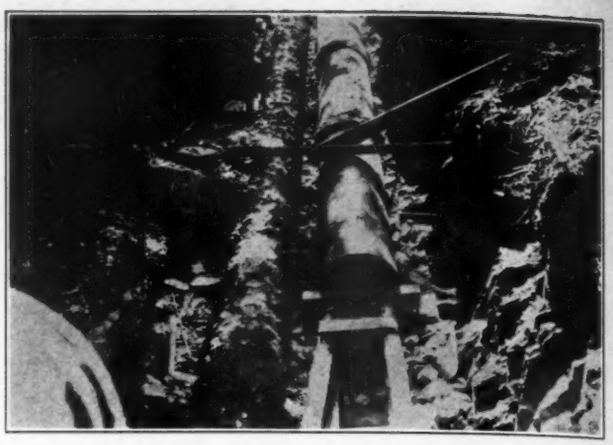
A Second P. W. A. Project

During the latter part of 1935, a grant of 45 per cent for the replacement of the remainder of the original wood stave pipe with 36-in. Cast Iron pipe was approved by the Public Works Administration. Construction of this project, again by Force Account, got under way on January 1, 1936. This job, having been approved under the 1935 Relief Act, made it mandatory to secure all but 10 per cent of the labor from the U. S. Relief Rolls. It was our experience that, by this time, such labor (with some few exceptions) had made up its mind that hard work was "bad for the body and injurious to the soul." We soon found that a greater use of mechanical equipment had to be resorted to if our estimates were not to be exceeded. Hence, more than half of the backfilling was accomplished with a bull-dozer and approximately 20 per cent of the excavation was done with a ditching machine.

James River Crossing

James River, at the point crossed, is approximately 425 feet wide and 12 feet deep to a rock bottom. The driving of steel sheet piles was out of the question and we used log sectional cribs, the inner sections being filled with rock, the outer with earth. Wakefield piles were driven on the water side of the cofferdam, built up of three layers of 2-inch lumber and well spiked. A deposit of earth on the outside of the Wakefield piles was necessary to prevent leakage. The working chamber was 21 feet wide and the leakage through the structure, after being unwatered, was handled by one 3-inch double-diaphragm pump. In constructing the second half of the dam, we attempted to use the Ohio River type of dam. We found, however, that this type did not have sufficient stability to resist the strong current of the river at flood-stage and had to rebuild most of it, using the original crib construction. We used a barge equipped with a 3-drum steam hoist and 50-ft. steel boom to handle materials. Piles were driven with a 3,000 pound steam hammer. The cost of the cofferdam was $56.00 per lineal foot of dam, such cost including both erection and demolishment. The pipe was bedded in a trench along the bottom of the river five feet deep. All underwater joints were made with friction type Dresser Couplings.

One of the Several Curves—The Going Not So Easy. Lynchburg's 36-In. C. I. Supply Line Replacing the 26 Year Old Wood Stave Line.



An Interesting Picture of the "Old and the New." On the Left Is the 30-In. Wood Stave Pipe Being Replaced by the New 36-In. C. I. Line. This Was a Really Tough Spot, Where the Slope (Behind the Camera) Was on a 64 Per Cent Grade. "Tramwaying" the Pipe Down Trench Into Position Had to Be Resorted to in Many Such Cases.

Comparison of Labor Output

	UNIT NO. 1 *Labor secured from U. S. Employment Office*	UNIT NO. 2 *Secured from U. S. Relief Rolls*
Earth Excavation (per cu. yd.)	2.78 Man Hours	3.55 Man Hours
Rock Excavation (per cu. yd.)	5.29 Man Hours	8.38 Man Hours
Backfilling (per cu. yd.)	0.88 Man Hours	0.86 Man Hours
Pipe Laying (per lin. ft.)	0.60 Man Hours	0.61 Man Hours

A Caterpillar Tractor equipped with side-boom was used for pipe laying on both units, most labor being City's Departmental Forces, hence the good showing. Excavation and backfilling on Unit No. 1 was all performed by hand, while equipment was used in part on Unit No. 2.

In undertaking the construction above described, the City accomplished a two-fold purpose:

1. It materially reduced unemployment and gave employment to shop workers.
2. Secured a capital installation of high economic value which, by reason of the permanent materials going into the works, assures the people of the City a continuous supply of water for several generations.

The writer wishes to take this opportunity to express his appreciation to the officials of The Lynchburg Foundry Company and to those of the Public Works Administration for their full co-operation and help in the performance of this major project.

56TH CONVENTION N.E.W.W.A. AT FAMED POLAND SPRING

Proves Unique, Enjoyable, Successful

Sunset, September 21st, Poland Spring, Me.

DEPARTING from custom, the annual convention of the New England Water Works Association was held far removed from the hustle and bustle of the large city. To its four-day convention, September 21st-24th, at famed Poland Spring, went approximately 600 members and guests to enjoy a unique and enjoyable convention favored by a sample of Maine's most perfect early Fall weather. The official count of registrants was 560 which was but 80, or thereabouts, less than that of the convention of 1935 held in Providence, R. I.

Holding the convention at a resort place far removed from the center of membership population was admittedly an experiment but the enjoyableness and success of the 56th Convention, as evidenced by expressions on many sides, seems proof sufficient that the experiment was a success.

High-spots of the convention, in addition to the weather and setting of the meeting place, was the entertainment provided by water works folks taking part on the Amateur Night program and the closing Barn Dance, to which beaux and belle came costumed in many hues and styles, to meet the fancy, to dance to the tunes of real Maine fiddlers.

Easy on golfers, but tough on dubs and those up too late "the night before," was Poland Spring's golf course, stretching from the front door of the hotel. Tennis, putting contests, obstacle golf, horse-shoe pitching, and even croquet, were available to conventioneers.

On the technical program, high-spots were the symposia on "Corrosion," "The Superintendents' Session," and "Gravel Packed Wells." New this year was the "Chemists' Round Table" held on the closing day, and running parallel with the always interesting and lively "Superintendents' Round Table."

Brackett Medal to Bunker

To George C. Bunker, Panama Consulting Engineer, Editor—Gordon M. Fair, Harvard University, Cambridge, Mass. went the Dexter Bracket Medal for his paper—"Water Supply Problems of the Tropics." The award denotes "the most meritorious paper appearing in the N.E.W.W.A. Journal during the year." In announcing the award, E. S. Chase, Chairman of the Award Committee, expressed regrets that Mr. Bunker, long a member of the association and for many years in charge of water supply and purification plants of the Panama Canal, was prevented from being present because of pressing work which required his presence in Venezuela. It was of interest that Mr. Bunker, a New Englander by birth, had figuratively cut his eye teeth as an embryo water supply expert, when he was assigned the job of making a biological survey of existing and proposed sources of supply for the Portland, Maine, Water District.

Officers Elected

As is customary with the Association the new officers elected or re-elected were announced on the closing day of the convention. These are:

President—Warren J. Scott, Chief Engr., State Dept. Health, Hartford, Conn.

Vice-Pres.—Geo. A. Sampson, Weston & Sampson Engrs., Boston, Mass.

Vice-Pres.—Percy A. Shaw, Engr. & Supt. Water Works, Manchester, N. H.

Secretary—Frank J. Gifford, Statler Bldg., Boston, Mass.

Treasurer—Leland G. Carlton, Registrar of Water, Springfield, Mass.

Directors—Roger W. Esty, Harry U. Fuller, Harold L. Brigham, F. H. Kingsbury, H. K. Barrows.

The President's Address

In his address as retiring president, Harry U. Fuller, Chief Engineer of the Portland Water District, proposed the establishment of State Sections in the Association in order that the average water works operator might better be served by bringing meetings closer to him and at more frequent intervals. Pointing to the success and growth of the monthly meetings held during the winter in Boston, Mr. Fuller felt that similar meetings held in other states would constitute a service worthy of serious consideration by the Association, and a step of progress and advancement.

Another point stressed by the President of N.E.W.W.A. was the importance of operating municipally owned water utilities on a business basis. Likewise, the need of publicity designed to reveal the true condition, the methods of management and also the profit or loss in

The Retiring President —Harry U. Fuller, Portland, Me.

The New President— Warren J. Scott, Hartford, Conn.

N.E.W.W.A.'s Hosts

Officers of Maine's Water Utilities Assn.—President, David E. Moulton, Portland; Secy.-Treas., Earle L. Tarr, Winthrop; Editor, Sidney S. Anthony, Augusta

N.E.W.W.A.'s Secretary, Frank J. Gifford

N.E.W.W.A.'s Treasurer, Leland C. Carlton

operating the public's enterprise. To such an end the keeping of adequate records, capable of ready interpretation, was an essential. Public Utility Commissions, created to prevent discrimination, were gradually requiring that water utility records be so kept as to reveal true financial and operating conditions—a service to the advantage of the public, and to the water works operator as well. This matter of operating on a business basis, rather than that based on political expediency, Mr. Fuller proposed as a topic of major consideration by water works associations seeking to best serve their members and, thereby, grow in usefulness.

Business Session

The Secretary's Report revealed a membership of 760 with several more applications to be reviewed by the Executive Committee. For the year a net gain of 23 members (at the opening of the convention) represented the first net gain in membership since 1929. Along with it had been an increase in receipts amounting to $6,600.

The following new Associate Members were announced as elected:

Activated Alum Corp., Baltimore, Md.
Carson-Caddilac Corp., Birmingham, Ala.
Field's Point Chemical Co., Providence, R. I.
Proportioneers, Inc., Providence, R. I.

The Treasurer's Report revealed the following:

Income received	$11,308
Total expenditure	10,953
Surplus	$ 355*

(*Compares with $800 deficit in 1936 report.)

Expenses of running N.E.W.W.A.'s headquarters offices amounted to only $3,834; Journal costs $5,041; received for advertising $3,082; interest on securities $499; net increase in income $6,600; worth of invested surplus (securities) $16,380; cash in bank $645.

The Editor's Report revealed that the gross cost of producing and mailing the Journal (3,680 copies) was $5,041.

That was equivalent to $6.53 per member, but when deducting income from advertising and reprint sales the net cost amounted to only 63 cents per member for each of the quarterly issues. Such per member net cost represented the lowest in 10 years, and compared with $1.97 per member in 1935-1936.

Welcome to Maine

The Welcome to Maine was delivered by David E. Moulton, Attorney, Portland Water District, a founder member of the Maine Water Utilities Association, and now its president. In his address, Mr. Moulton had some fun at the expense of the engineers, when he commented that as a lawyer he had reached the opinion that "a consulting engineer a long way from home on a witness stand, with a slide rule, was the most extraordinary thing imaginable." He referred to the engineer at valuation and rate hearings "at which the virtues of cast-iron pipes are extolled to heights only exceeded by values of intangibles."

Following Mr. Moulton's brief talk, H. E. Jordan, Secretary of A.W.W.A., was introduced by President Fuller as an honored visitor.

Papers and Discussion

The opening paper on the technical program constituted an analytical review of:

"The New Uniform Accounting System for Water Utilities in Maine" by ALLAN F. MCALARY, Treasurer, Camden and Rockland Water Co., Rockland, Me.

The present accounting requirements of Maine's Public Service Commission for water works utilities dates from 1915. On January 1, 1938, the new system will go into effect, and applies to municipally as well as privately owned water utilities. Mr. McAlary in reviewing the principal changes pointed out that three classifications would appear based on gross revenues. Class (A) $50,000 and up; Class (B) $10,000 to $50,000; Class (C) $10,000 and less. Accounts were more subdivided and detailed; as to water rates there were 15 divisions; the source of supply accounts had been divided into investments and revenue; transmission mains, divided into supply or trunk mains and distribution mains; forestation of land was a new account; supervision costs divided into pumping, treatment, distribution; depreciation split to show land values and equipment; overhead costs to be allocated to jobs. An important change was the "work-order plan" involving detailed costs on a job to be filed under account numbers to simplify future evaluation proceedings.

In the discussion, H. E. Jordan, Sec'y. A.W.W.A., noted that the National Association of Utilities Commissions were evolving a very similar plan and wondered if the Maine plan was in parallel. President Fuller answered that it was Maine's intent to follow the National plan as closely as feasible. Mr. Moulton pointed out that in districting the accounting, the Portland Water District would be required to maintain 16 different accounts and potentially as many different water rates would be required to distribute cost of service equitably. To some the plan of maintaining separate accounting for each district seemed needlessly refined, too detailed, costly, and burdensome. It was true that the required accounting by Public Service Commissions would render it less easy for municipalities to transfer funds from profitable water utilities to the general fund, but there was no ruling that prohibited such practices. In the new "Work Order Plan" it would be essential to util-

Officers

Harold L. Brigham, Marlborough, Mass., Director; Geo. A. Sampson, Boston, Vice President; Karl K. Kennison, Boston, Chairman Program

ize a time card system in allocating costs which had not been necessary under the present plan.

"The New River Crossing at Augusta, Maine" by SIDNEY S. ANTHONY, Engr.-Supt., Water District, Augusta, Me.

Mr. Anthony with benefit of lantern slides, described the recently completed river crossing designed by himself for Augusta, which involved 760 ft. of 16 inch cement-lined Universal cast-iron pipes laid in 6 ft. trench under concrete slab, at a total cost of $85,000. The new crossing was to eliminate dependence upon two 10 in. lines on bridges subject to flood damage. He described the methods of coffer-dam construction and severe losses suffered due to flood waters during construction. Pumping proved a costly operation in consequence, being $8,600 as compared to cost of $5,100 for the pipe and laying. Most impressive was the beating taken by the designer and builder at the hands of "Old Man River" and methods of fighting back; also, the fact that the completed line under 140 lbs. head showed almost no leakage at all—only 10 per cent of that allowed.

"Meeting the Demand for Recreational Facilities Near Public Water Supplies" by DAVID E. MOULTON, Atty., Water District, Portland, Me.

Mr. Moulton reviewed developments in an effort to maintain the water supply of the Portland Water District, from Lake Sebago, in good sanitary quality. Now 90 per cent of the shore line within 2 miles of the intake had been purchased. Boating on the lake and camping and trespassing on portions of the watershed not owned by the District, however, constituted a menace and annoyance. Constant patrol was necessary during the summer season and bathing was prohibited. Since 1913 chlorination had been employed and since 1919 automatic chlorination at rates varying seasonally from 1 to 5 lbs. per m.g. Now experiments were under way with a Laughlin magnetite self-cleansing filter at the chlorinating station.

The latest move to attract campers and recreationists from the watershed area constituted a development of a recreational area adjacent to Lake Sebago, as a W.P.A. project. The Portland Water District had purchased 5 ponds from an ice company and area sufficient for the development of camping grounds, ball park, picnic grounds and the like. The area was being subdivided for 5 uses and a sand bathing beach established on one pond. The others were being stocked with salmon and trout and utilized for boating. The project had been under way for one year. Labor valued at $40,000 had been supplied through W.P.A. and the Water District had contributed the property and $4,000 for equipment and materials. What authority was to administer and operate the property after completion had not been decided. Mr. Moulton, in answer to a question, hoped that the Water District would not have it to do. In reply to another question he said that there was no law in Maine prohibiting bathing in public water supply. In Portland's case boating was more a problem than bathing.

F. H. KINGSBURY, SR., Asst. Engr., Mass. Department of Health, said that he saw an excellent solution to the trespass problem in Portland's plan, which answered the question of trespassers—"Where else can we go?"

ADOLPH MUELLER, Mueller Co., Decatur, Ill., who served on the Decatur Water Works Board, told of having dammed the Sangamon River for water supply. Soon after a municipal bathing beach was established only 2 miles from the intake; fishing and boating 0.5 mi. therefrom. With this he had never agreed and had learned something from Portland.

"The Economics of Water Purification" by E. SHERMAN CHASE and ARTHUR L. SHAW, Metcalf and Eddy, Engrs., Boston, Mass.

This interesting paper, presented in abstract form by Mr. Chase, constitutes an attempt to evaluate the worth of water purification to a community on a dollars and cents basis. Most impressive of all was the picture of what a water borne typhoid epidemic had only recently cost one city lacking adequate purification facilities. In this instance damage claims amounting to more than $425,000 had been paid. In the reduction of the typhoid death rate of 35 per 100,000 in 1900 to less than 5 per 100,000 in 1936 the authors credited 50 per cent of the reduction to water purification and an estimated saving amounting to $20,000 per year per million gallons of water purified.

Concerning tastes and odors, purchased drinking water (where bought extensively) entailed an expense to citizens justifying $10,000 per year per M.G. for purification. Corrosion, necessitating main cleaning every third year at 9 cents per foot justified corrective treatment costs of $16,000 per year for every 100 miles of mains requiring such maintenance. Consumers' services and interior piping suffered estimated damage to the extent of $15,000 annually and therefore a total of $31,000 annually per 100 miles of mains. Softening could be adequately proved worth $150 per year per M.G. ($3.50 per capita per year) to remove all hardness above 100 parts per million. Iron and manganese removal, probably worth $1,000 per year per M.G. for every part per million reduction, was hard to evaluate, but de-

At the Barn Dance

Mr. and Mrs. "Clint" Inglee, Mrs. Chas. Eastwood and Mrs. Robt. Browning, Mrs. Harry Fuller and the President.

(Left) The Hog Callers' Quartet—Geo. Haggeter, Mickie Newman, Joe Wafer, Jack Butler. (Right) John Ward, Mrs. Leland Carlton, Mr. Carlton and Mrs. Ward.

cidedly worth more than $8.55 per M.G. cost of treatment. Intangible benefits from treatment were many, and difficult of evaluation.

In reply to questions, Mr. Chase cited Lawrence, Mass., where records showed an expense for purchased bottled water amounting to $2.00 per capita per year. He admitted the difficulty in appraisal of costs of iron, manganese, color or turbidity removals per unit, because of the fact that little or much of either could be removed with but little change in operating costs. The removal of color to 10 parts and turbidity to 5 parts was apparently worth the expenditure of $200 to $400 per year M.G. respectively for each p.p.m. removed.

Corrosion Symposium

(Dr. F. N. Speller, National Tube Co., Leader.)

In opening the symposium on corrosion, Dr. Speller briefly reviewed the **"Principles of Corrosion and Its Prevention."** The electrolytic theory was explained by picturization to show the effect of dissolved oxygen in natural waters as a destroyer of the protective polorizing hydrogen film and, thereafter, continued corrosion of unprotected metal surfaces. He explained the role of lime and other alkalies in treatment for corrosion control as providing cathodic protection by film building. On the other side was the Chromium treatment, providing anodic protection. All important in pipe corrosion was the velocity effect in scouring away the protective products of corrosion, or film formation generally.

For correctives, Mr. Speller pointed out that selection of protective treatment, as against the use of more resistant pipe materials or protective linings, was essentially a matter of expediency and economics. He also touched on modern coatings for soil corrosion and the imposing on pipe lines of electric charges for cathodic protection.

"The Corrosion Problem in Cambridge, Mass.," by MELVILLE C. WHIPPLE, Assistant Professor Sanitary Chemistry, Harvard University, Cambridge, Mass.

Professor Whipple reviewed the findings of corrosion studies at Harvard University which revealed that treatment of the filtered Cambridge water with soda ash to reduce the free CO_2 content to 1.5 p.p.m. proved insufficient protection to pipes of steel, brass, Muntz metal, Admiralty metal. In 1930 treatment with lime had been introduced with some benefit noted. Only since 1934 when the lime had been boosted to a point where no calcium carbonate would be dissolved (pH 8.8 to 9.0) had the treatment been as effective as desired. Observations on test piping indicated copper, red-brass and Admiralty metal to be unattacked, and complaints from consumers and plumbers reduced to a minimum. For household piping, however, copper seemed the most satisfactory material under all conditions.

"The Influence of Dissolved Oxygen in Accelerating the Corrosive Action of Waters" by F. W. GILCREAS, Sanitary Chemist, New York State Department of Health, Albany, New York.

Read in his absence, Mr. Gilcreas' report revealed the effect of dissolved oxygen in aerated water from deep-wells on Long Island in intensifying corrosion. The unaerated deep well supply of West Hempstead contained 2.6 p.p.m. of CO_2 (pH 5.1) and only 0.3 p.p.m. dissolved oxygen. Although, markedly unsaturated to calcium carbonate it had given no trouble from main tuberculation or red water on dead ends. On the contrary a very similar and nearby well water at Freeport, L. I., had been completely aerated (9 p.p.m. D.O.) in an iron removal operation. The result is a very rapidly corrosive and tuberculating water and noticeably rapid attack of brass pipes. In a third nearby supply, from Layne deep wells, aeration boosted dissolved oxygen to 9 parts; pH to 6.4. In this instance no tuberculation or corrosion troubles had been encountered. In summary, Mr. Gilcreas stated that the evidence did not favor the theory that dissolved oxygen unduly intensified corrosion. There was very little difference in the effect on the iron pipes, regardless of oxygen differences.

(1) Mr. and Mrs. J. Herbert Smith; (2) Mrs. "Mae West" Kelly and W. J. Michel; (3) Miss Helen Glasier and Charlie Decker.

(1) "Dude" Enslow and "Beau Brummel" Stuart—"Go to Town"; (2) Mrs. A. Tournier; Mrs. "Jeff" Corydon and Friend Hubby; (3) "Hot Shot" Arthur Clark and Mrs. "C."

"The Neutralization of Corrosive Action" by ROBERT SPURR WESTON, Consulting Engineer, Boston, Mass.

Mr. Weston, in reviewing corrosion control by chemical treatment, concluded that on a practical basis the application of lime remained the favored means of bringing the finished water into chemical balance. It appeared, however, that it was not practical to treat a water so that it would be in best condition for both hot and cold water services simultaneously; and, therefore, it seemed overall best practice to select the middle course and supply a median treatment. In pefecting control of alkali application Mr. Weston referred to automatic potentiometric (pH) control now made feasible by Leeds-Northrup instruments. Such equipment on systems under his supervision had been dependable in controlling the pH value within a range of 0.1 pH.

As to the application of silicates of soda, only the cost was against its utilization. There seemed to be a thin protective coating of silica jel deposited and when silicate treatment was intermittently applied to supplement lime treatment the overall effect was superior at a median cost. A reduced attack on lead had been noted

where silicate application and lime treatment is alternately applied.

The maintenance of more nearly sterile conditions in mains and pipe lines, for suppressing biological growths and bacterial activity, responsible for tubercule building and corrosion, was briefly covered. Cases were cited in which ammonia-chlorine treatment to maintain residual chlorine had proved efficacious.

In the smaller supplies passing the water through contact beds of marble chips had been helpful in rendering waters less corrosive and had the advantage of requiring little if any supervision or control. In this same direction a German development of interest involved the use of chips of roasted dolomite. The product, known as "Magno-Doublesalt," had only the carbon dixoide of the magnesium carbonate driven out and the calcium carbonate remained unchanged:

$$Mg\ CO_3 : Ca\ CO_3 = (Mg\ O : Ca\ CO_3) + CO_2$$

Advantages claimed for the material were that it had a more rapid reaction than marble chips (less contact period required) and had the capacity of removing more carbon dioxide per pound of material. The material gradually dissolved away and, to avoid chokage, the resulting fines of 1 m.m. diameter and less were removable by backwashing the bed. For each 1 p.p.m. of CO_2 removed, 10.8 lbs. of "Magno-Doublesalt" would be consumed per million gallons treated—the hardness increase being 1.75 p.p.m. for each part of CO_2 fixed. A volume of the material amounting to 7,000 to 9,000 pounds per m.g.d. plant capacity is recommended to provide the required contact surface. So far, the material is not available in America but sells in Germany for 112.5 R. marks per long ton (2,200 lbs.). At this figure the cost of removing 20 p.p.m. of CO_2 would approximate $5.00 per m.g. for the "Magno-Doublesalt" required. Such cost compared with $4.15 for treatment with hydrated lime, and $8.30 with soda ash. Mr. Weston said that he understood that the roasted dolomite was to be produced in America also. Its chief advantage in small installations was that no supervision was required in operation, beyond replenishment of material and bed washing at intervals. A treated "Magno-Doublesalt" was being offered for manganese and iron removal in addition to corrosion control.

General Discussion: In the delayed free discussion of all papers on water treatment for corrosion control the following developed:

MALCOLM PIRNIE pointed out that the soft Providence water required lime adjustment to pH of 9.6, producing a total hardness of 31 p.p.m.; whereas, others of higher initial calcium content had required adjustment to pH 7.8 or 8.0, only, indicating that there could be no set figure for a pH effective on all waters.

E. S. CHASE related experiences at Falmouth, Mass., wherein adjustment to pH 9.0 had been effective in winter but not so on dead ends or sluggish mains in summer. Hardness of the untreated water was but 5 p.p.m.

D. A. HEFFERNAN stressed the galvanic effects noted on the Milton system and therefore the ill effects from dissimilar metals joining each other, regardless of the treatment. By employing similar materials he had largely corrected the trouble.

DR. SPELLER called attention to the effective use of the vacuum deaeration system such as recently installed by the Freeport, Texas, Sulphur Company. (See WATER WORKS AND SEWERAGE, May, 1937, Reference and Data Section, p. 223—"Corrosion Control by Deaeration"—S. T. Powell and H. E. Bacon.)

L. H. ENSLOW found interest in the Falmouth problem, reported by Mr. Chase, because it drew attention to the effect of biological action in creating corrosive conditions in dead ends and sluggish flow sections generally. This constituted a problem at numerous places and called for some form of sustained sterilization effect extending to the far reaches of the system during the period when water temperatures permitted biological activity which was not noted in winter. It was just such cases that ammonia-chlorine treatment proved most effective in remedying. On the heels of effective flushing should follow the treatment, advanced by degrees; to maintain at least some residual chlorine at remote points where bacterial degradation of pipe slime was ordinarily most pronounced; odors, tastes, red-water or black-water most acute. The treatment was to be considered supplementary to lime treatment.

In commenting on the "Magno-Doublesalt," Mr. Enslow thought it extremely interesting where freight haul was an important element. However, where high-grade crushed limestone or marble was available at a cost less than the more active "Magno-Doublesalt," selection should be made on a net cost basis. It was difficult to see any chemical advantage to the calcined dolomite and if the theory and claims were proven the magnesia would go before the calcium carbonate. As the usage progressed, the bed would eventually be mostly the more resistant residual calcium carbonate. With a bed of 100 per cent calcium carbonate, obviously a longer contact period would be required because of its slower solubility. As to supervision, limestone or marble beds should require no more attention than the "Magno-Doublesalt."

Mr. and Mrs. Bob Browning; Mr. and Mrs. Charlie Eastwood.

(1) "Jimmy"—"The Convict" Angell and Madam (?) Jim Harding; (2) Mr. and Mrs. Jerry McCarthy; (3) Mrs. E. T. Dowell, "Guy" Northrup; Mrs. J. W. Coburn.

An Afternoon for Sports and Sunshine

(1) *Ladies' Obstacle Golf Putting Contest;* (2) *A Foursome—McNulty, Hoy, McGary, Replogh;* (3) *Three of an important gallery that followed them around—W. C. Hawley, Frank Barbour, Steve Taylor;* (4) *Another Foursome (Without Benefit of Gallery)—Angell, Stuart, Sigworth, Krum;* (5) *Theodore Bristol Doing a Nice Job of "Out" at Croquet—Because He Had His Coat Off He Pled With the Cameraman to Suppress this Shot*

"Development and Use of Spun Bituminous Coatings for Water Pipes" by GEORGE E. BOYD, District Manager, Wailes Dove-Hermiston Corp., New York City.

Mr. Boyd briefly reviewed the findings, to date, of ground corrosion studies being made jointly by the U. S. Bureau of Standards, American Gas Association and American Petroleum Institute—in which had been revealed the effective protection afforded by properly applied coal-tar enamels as compared to the more absorbent (porous) asphalt coatings. He reviewed the improvements made in tar enamels, as to toughness and improved temperature range between cracking and sagging. To take care of soil stresses, harder and thicker coatings with spiral wrapping, had been developed. Especially important was the method of application of tar enamel linings and coatings, the best jobs being done as shop practice. In discussing the question of thickness of metal, Mr. Boyd showed that it was economic folly to go beyond wall thickness for strength requirements when dependable protective coatings were available to prevent metal loss due to pitting. In the present day, should the coating fail at spots, cathodic protection against exterior pittings was now available as the last line of defense. In modern practice it seemed good economic engineering to make soil surveys with the Sheppard soil conductivity rod and protect for the spotty conditions to be met with along the location right-of-way, rather than waste materials and effort where not warranted. Since the average engineer, or city, was not equipped for making soil surveys, it was suggested that the coating manufacturer be given the job of making such surveys; and, furthermore, that he be required to guarantee sustained protection over a number of years. As to the cathodic protection secured by carrying an electric charge on the line, its success and economy depended upon having a dependable coating of good dialectic properties. With it all, it might safely be said that "the bugaboo of soil corrosion is no more."

ROGER ESTY (Danvers, Mass.) in reply to a question raised on the floor, stated that he had long used cement lined pipe in the distribution system. More recently they had installed 3,000 ft. of Bitumastic lined 8 in. pipe, which fire flow tests and lack of taste complaints had convinced him to be superior to the cement lined pipe. W. W. BRUSH (New York City) said that the taste difficulty with cement linings in New York City had been overcome by a cold tar-spray coat applied to the cement to seal in the soluble products in the cement. Experience with asphalt and tar-base linings had shown them equal for the first 10 years, but the asphalt blistered after that, whereas the tar enamel seemed good for 40 or 50 years. Cathodic protection was new to him, but sounded promising. PERCY A. SHAW (Manchester, N. H.) said that failing to get proper guarantee on Bitumastic lining from the foundry they had been using cement lined pipe dipped in tar. D. A. HEFFERNAN (Milton, Mass.), long a user of cement-lined pipes, said that such linings had been markedly improved. DR. SPELLER explained the chemistry of the metal protection by the cement lining, as being that of excluding oxygen and providing a high pH value at the metal surface. In reply to a question he said that the adhesive mill-scale should not be removed from steel pipes before dipping or lining. Only wire brushing was desirable. With this, Mr. Boyd was in agreement.

"Grounding of Electric Currents on Water Pipes —A Committee Progress Report" by GEORGE A. SAMPSON and DAVID A. HEFFERNAN.

As Chairman of N.E.W.W.A.'s Committee on Electrolysis and Grounding, Mr. Sampson presented a report on the progress being made by the recently formed American Research Committee on Grounding, in which studies are being made to detect deleterious effects to piping, water meters, and water quality due to current practices of grounding household wiring systems on water piping. Following the quantitative study as to effect from various quality and quantity of current flow methods of grounding to overcome the effects were to be studied and perfected. Investigation of 22 cases of complaint had so far failed to reveal any common cause and no conclusions were permissible.

H. E. JORDAN pointed out that the investigation had proved much more current flowing from residences on water pipes than anyone had been willing to admit in the early stages of the cooperative study. W. C. HAWLEY (Wilkinsburg, Pa.) told of a case of electrolysis charged to a street railway which had actually been traced to a residence. Others told of cases of 35 amperes flowing; dissolving of copper pipe due to radio connection; severe shocks to employees removing water meters. Mr. Boyd pointed out that as little as 1 ampere of current flow will take away 35 pounds of iron in a year.

"Spillway Design for the Bills Brook Dam" by WM. DORENBAUM, Designing Engineer, Metropolitan Water District, Hartford, Conn.

Mr. Dorenbaum described, through use of motion

Walter Parker, Dept. Mgr., Pittsburgh Equitable Meter Co.; Stephen H. Taylor, Supt. Water, New Bedford, Mass.; Col. F. F. Longley, Vice-President, Lock Joint Pipe Co. (All Added to the Technical Program)

Here and There at Poland Springs

(1) Chas. G. Richardson, Builders' Iron Foundry, and Roger Esty (Immediate Past President of N.E.W.W.A.), Supt. Water, Danvers, Mass.; (2) Wm. C. Sherwood,, V. P. Hersey Mfg. Co., and Mrs. Sherwood; (3)"Hi" Burgess and His Boss, Jas. H. Egolf, Ludlow Valve Co., Troy, New York; (4) Weston and Sampson, Boston Engineers—Only in This Picture It Is Geo. Sampson and Bob Weston; (5) "Jo" Conners and His Boss "Clint" Inglee, National Water Main Cleaning Co., New York City

pictures, the model studies conducted by Worcester Polytechnic Institute on spillway models to 1/30th scale for the Hartford Metropolitan Water District. The cost of the tests was $5,000 and the tangible saving in design was $35,000. In addition, the benefit of demonstration over paper figures was a decided asset in the nature of design assurance. Interesting were the slow motion pictures revealing jet and scour effects, too fast for the human eye. He commented that the revelation

Corrosion Busters

Dr. Frank M. Speller, National Tube Co., Pittsburgh, Penna.; Geo. E. Boyd, Wailes Dove-Hermiston Corp., New York City; Prof. M. C. Whipple, Harvard Univ., Cambridge, Mass.

that up to 65 per cent submergence made no appreciable difference in the wier discharge curve proved foreign to what has been taught in text books.

Superintendent's Afternoon

(Percy A. Shaw, presiding.)

"Qualifications of Operators of Water Treatment Plants" by WARREN J. SCOTT, Bureau of Sanitary Engineering, State Department of Health, Hartford, Conn.

Mr. Scott's paper constituted a review of the status of water treatment plant operator certification or licensing in America. In 1937 Connecticut had joined the following states having specific laws or regulations pertaining to qualifications and appointment of water purification plant operators, to wit: California, Kentucky, Michigan, New Jersey, New York, Ohio, Washington, West Virginia. Voluntary operator certification systems were operative in California, Texas, Georgia, South Carolina. Almost identical with the law in regard to approval of the appointment of sewage works operators, the new Connecticut law provides the qualifications of the plant operator appointed must meet the approval of the State Department of Health, there being no distinction between operators employed by governmental subdivisions and privately owned utilities. There is no requirement as to licensing or certification under the law as it now stands. However, some form of legalized certification appeared to be worthy as benefiting operators as well as the approving authority. In Michigan and New Jersey the apparently workable licensing laws seem to have many requirements and enforcement procedures in common. And in West Virginia the law had the sympathy and endorsement of privately owned water utilities before and since it went into effect.

In summarizing developments in operator licensing and looking at the future, Mr. Scott, concluded that there were definite advantages to be gained from specific laws establishing qualifications for water plant operators. Aside from keeping out unqualified and inexperienced individuals, the calibre of plant operators would be raised and, therewith, opportunities for more adequate salaries. Meeting specified requirements would influence the public to a higher recognition of operator and tend to bring on a demand and sentiment for continuity of office for qualified men. Water Works associations were properly the agencies to promote operator certification and licensing movements. The sooner the public gets the idea that the business of operating a water works is a profession rather than a political foot-ball, the better will the public be served and the more appreciated will be the operating staff.

F. H. KINGSBURY, Mass. Dept. of Health, said that the construction of a number of filtration plants in Massachusetts had brought the operator problem to the fore. Most cities in Massachusetts operated under Civil Service and city authorities ask the Department of Health for specifications covering operators. Seemingly, in Massachusetts, the matter will finally rest with Civil Service and some form of approval by the Department of Health.

"Fire Hydrant Connections and the Control of Dual Mains" by ARTHUR F. BALLOU, Engineer, National Board of Fire Underwriters, New York City.

Mr. Ballou's paper pointed out the shortcomings and difficulties of effective valving and control in the

"Hit or Miss"

(1) John Kienle, in the Pond, Plays One 4 Inches Under Water for a Perfect Out—Note the Splash Opposite Left Shoulder; (2) W. C. Laughlin, H. U. Fuller, L. H. Enslow at Portland's Experimental Filter; (3) S. J. Kyle and Dave Heffernan Were Busy Discussing the Virtues and Shortcomings of Fire Hydrants Just as This Was Snapped in Front of the Hotel. This One Proved to Be a Matthews 1893 Model.

usual design of dual main systems as now in existence or proposed, involving double the number of valves and main mileage. The scheme he proposes, for simplification, reduces the number of valves by ¼th, and principally the larger sizes of valves. A domestic service line runs around two sides of the block, the fire service mains around the other two sides. Each fire hydrant is served by north-south and east-west mains, which cross each other near the hydrant and interconnect through a by-pass created by a loop on which the hydrant sets. Shut-off valves between hydrant and each of the two mains makes it possible to feed the hydrant from a single main or both. [Better understood would be to see the plan on paper.—Ed.]

"Modern Practice and Developments in High Pressure Reinforced Concrete Pipe Lines" by COL. F. F. LONGLEY, Vice-Pres., Lock Joint Pipe Company, Ampere, N. J.

Colonel Longley, in a manner of presentation as excellent as the moving picture employed, described the 1937 methods of fabricating and laying of Lock Joint reinforced concrete pipes. The picture was made on the Little Rock, Ark., project and revealed methods of construction of the reinforced welded steel shells; pouring of the concrete; the improved handling, jointing and laying of the pipes. In reality, the steel shell is designed and tested as a steel pipe for the service intended and the spiral wound reinforcing, with concrete shell, serves as the protective case around the steel tube. Concrete density and uniformity had been increased by employing a very dry mix of mortar, efficient high speed vibratory tamping, steam curing. The Little Rock pipes were designed for various heads, the maximum being 400 ft. whereas about 60 per cent was for 200 ft. head.

Regulated Filter Wash

"The Measurement of Sand Expansion" by H. J. KRUM, City Chemist, Allentown, Pa., and EVERETT M. JONES, Simplex Valve and Meter Co., Philadelphia, Pa.

Presented by Mr. Krum, this paper told of the development of a floating sand-expansion indicator for use in determining the proper opening of the wash water valves for effective but at the same time economical rates of wash water applications. Realizing that some definite expansion of sand bed for effective washing was an essential to good practice, and having determined that standardized practice on the part of the various filter attendants was highly desirable, various schemes of wash control had been tried. The most successful had been the development of a properly ballasted small diameter cone shaped float, resting on the sand surface and floated up with the liquefied bed during washing. A chord over a pulley to a counter weight operated the indicator dial revealing the height of floated filter bed level and per cent expansion.

With the aid of moving pictures, of a section of filter with glass front, Mr. Krumm explained the operation of the expansion indicator with clean sand, dirty sand, "Anthrafilt", and Zeolite. Regardless of temperature change of the wash water or the nature of the filtering material the expansion-indicator seemed to give an accurate reading of bed expansion and allowed standardization in filter washing. Its use eliminated the need for calibrating valves or employing tables to show valve opening or flow rates required at various wash water temperatures and for different filter materials.

(Mr. Krumm's paper appears in full elsewhere in this issue.—Ed.)

In reply to questions, Mr. Krumm stated that the experimental 2 inch floats were sufficient for the large filters, larger floats were not as accurate. To detect spotty washing of filters the instrument could be moved from point to point by hand and the readings noted. By closing the wash valve with float indicator as a guide the density of filter bed could be varied at will.

E. M. BATTEY, Chemist, Providence Filtration Plant, told of the Providence method of changing valve settings with changes in water temperature to secure desired bed expansion. Mr. Krumm replied that he had attempted the same procedure but found it far from simple to calibrate the several valves for various temperatures.

"New Developments in Fluid Meters Which May Affect Water Meter Designs" by WALTER PARKER, Dept. Manager, Pittsburgh Equitable Meter Co., Pittsburgh, Pa.

Mr. Parker in a brief historical review called attention to the fact that the first service meter in America was installed in 1866; the first meter of the Venturi type in 1887. Beginning in 1890 consumer meters began to be generally used and now about 7 million were in use. Concerning the design and accuracy of service meters he pointed out that gasoline meters were accurate to 0.1 per cent; beer meters 0.2 per cent accurate. In answering the question, "Why are water meters not built for greater accuracy?" Mr. Parker explained that the initial cost as well as maintenance cost was the chief reason. Closer clearance required of moving parts would rule out use of water lubricated hard rubber, as now practiced. Starting with greater accuracy there would be more stoppages (sticking), more consumer complaints. Taking a five year period the net result, due to wear, would be to have less average accuracy than that given by meters with present clearances.

In studying the matter of building higher accuracy into service water meters, the value of the product measured did not seem to justify the added initial and operating costs involved. For example, the average domestic meter measures only $12.00 worth of water per year. The present standard of accuracy of 1.5 per cent for American meters, under American conditions, seemed to be more practicable all around than attempts to maintain a higher accuracy such as the 0.5 per cent of some foreign meters. In the end analysis, metering practices must be economically sound as well as technically satisfactory. When the cost seemed justified greater accuracy could be built into service water meters, but justification for such constituted a question needful of more proof than the present analysis revealed.

J. HERMAN SMITH (Hersey Meter Co.) came forward with the worthy suggestion that water works operators on the whole should seek their deserved recognition through greater attention to local publicity. To friends of operators on the outside this seemed more important for the present than so much attention to minute technical details. To attain a standing and recognition water departments must, in the first analysis, be efficient. In looking to greater efficiency in water works operation, Mr. Smith offered the suggestive thought that water departments would do well to strive to approach the efficiency of the present day water meter—assuming of course, that the care given the latter instrument is to some reasonable degree efficient.

(To Be Concluded)

[The next and final installment of this report will cover the Superintendents' and the Chemists' Round Tables, held on the closing day of the convention, and the Symposium on Gravel Packed Wells.—Ed.]

MEASURING SAND EXPANSION IN FILTER WASH CONTROL*

An Improved Method, Involving the Development of an Expansion Indicator

By H. J. KRUM† and EVERETTE M. JONES††

THE purpose of this paper is to report on studies made on the design and adaptation of a sand-bed float for indicating sand expansion, in an effort to better control, and increase the efficiency of filter washing.

With the exception of filter washing, practically every step in the process of purification of water in a rapid sand filtration plant is controlled by meters and tests. In most plants filter washing is too much a rule of thumb operation or, else, a personal judgment procedure.

The shift operator may be limited to a definite period of time and wash rate; but as a rule he is relied upon to use his own judgment as to the manner of reaching maximum wash velocity, the length of wash at this rate, and the rate of closing the valve at the end of the wash. This is particularly true in the smaller plants and the eye and personal opinion of the operator may or may not prove wholly dependable.

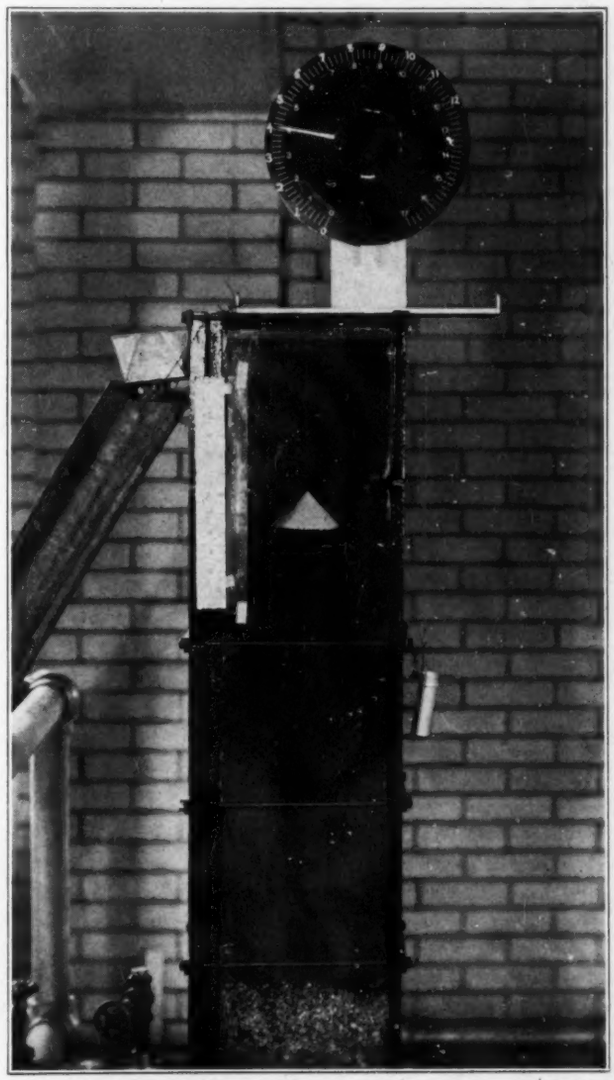
Allentown has a 10 M.G.D. filtration plant, consisting of 8 filters, each filter having a capacity of 1.25 M.G.D. Our plant is not provided with a wash water rate indicator, therefore, we have no visual means of knowing the rate of application of wash water and must depend entirely upon the judgment of the operators. A study of the filter washing records shows that one of the operators used an average of 4,600 gallons, or 12 per cent less wash water per filter, than the other four operators. One of the observant operators brought up the question as to who was washing the filters most correctly. Obviously, the answer was not simple and emphasized a need for standardization in filter washing at our plant as elsewhere. It was this which led to the developments to be reported now.

Washing Studies

Our first attempt was to establish a standard turbidity end point in washing, involving use of a photo-electric cell submerged in the dirty wash water. This failed, for reasons which will not be discussed in this paper. It is enough to say that clarity of effluent wash water is no index that accumulating dirt has been effectively freed from the sand grains.

In a search of the literature for some procedure or apparatus that might serve as a more scientific method of filter washing, we found that Hulbert & Herring's "Studies on the Washing of Rapid Sand Filters" [1] describes two methods for measuring sand expansion in filter washing. Briefly, the first is a submarine lamp, which is lowered into the filter until the light bulb disappears beneath the surface of the expanded sand. The per cent bed expansion is revealed by this ratio of depth of the floated bed and that of the bed at rest. The second method involves the use of a floating sand expansion indicator, which will be discussed in detail later. Inquiry revealed that this piece of apparatus was not on the market, but that the Simplex Valve & Meter Co., of Philadelphia, had been given the sole rights to its manufacture.

Our objective was a sand bed that did not have cracks; one that was practically free from mud balls and that did not pile up sand in the corners of the bed, or pull away from the side walls. We learned that a bed containing clean sand does not have these objectionable features. Baylis[2] considers filters in excellent condition



Sand Expansion Indicator in Action: This Picture Was Made from a Movie Film of a Complete Wash. At This Stage There Was a 20 Per Cent Bed Expansion. Note the Dirt Rising and Check of Scale Measure Against Indicator Hand. Floats for the Plant Filters Are of the Same Dimensions as That Shown Here.

*This paper, read before the New England Water Works Association, and is here presented by permission of the Editor of the Association.

†City Chemist and Supt. Filtration, Allentown, Pa.
‡Simplex Valve & Meter Co., Philadelphia, Pa.

when the volume of mud balls in any part of the bed is not greater than 0.1 per cent of the volume of sand. And, when greater than 0.2 per cent, remedial measures are needed to avoid trouble. Hulbert & Herring[1] state that "If a filter is composed of very clean sand (2 per cent of coating or less) all mud mounds are absent, no shrinking whatever takes place." Another author[3] states that the clarity of the final wash water is the usual criterion of cleanliness of the filter bed. While it may be usual it may not prove a dependable criterion unless other effects are adequate.

Washing Methods

1—The early rapid sand filters were back washed, after a short period of mechanical agitation or bed scrubbing with air, with a comparatively low velocity wash. Later, the mechanical or air scrubbing lost its popularity when higher velocity water wash was introduced.

2—In 1929, Hulbert & Herring introduced even higher velocity wash.

3—Baylis, more recently, advocates surface jet-wash in combination with moderate velocity upward wash, as the more effective and economical scheme.

Armstrong points out that "It can readily be seen that any change in the depth and grading of sand, the water temperature and the rate of applied wash water, will affect the level of the top of the sand bed during the washing period."

Allen Hazen presented a formula for calculating sand expansion from the sand size, temperature of wash water and sand depth. Hulbert and Herring also used these factors for the same purpose.

Hulbert and Herring[1] found that by employing a 50 per cent sand expansion, by the application of a relatively high velocity wash, the filter sand could be kept clean and long filter runs obtained. These investigators state, however—"We are not prepared to claim universal applicability for the expansion index, however, it may very well be that sands of different characteristics require different degrees of expansion for satisfactory cleaning."

W. C. Lawrence,[4] at Cleveland, obtained similar results with the 50 per cent sand expansion, reporting a 69 per cent increase in hourly period of service for each filter. The total amount of wash water saved in a three-year period was 771.5 million gallons. At a cost of $40 per million gallons the total was $30,860.

J. Clark Keith[5] has reached the opinion that it is important that sand expansion be accurately checked at regular intervals to compensate for changing conditions.

George F. Gilkison,[6] at Kansas City, Missouri, shows that a wash water temperature of 85 deg. F. and a wash water rate of 24-inch vertical rise, expanded the sand 33 per cent; whereas, with a temperature of 33 deg. F. and the same 24-in. rate of rise the expansion was 53 per cent. Further, that no benefits were gained by expanding the bed in excess of 40 per cent.

Baylis[2] advocates the use of the water jet surface-wash, followed by a 35 per cent sand expansion with up-flow wash, for keeping the sand bed clean. Herbert E. Hudson Jr.[7] of the Chicago Experimental Filtration Plant cites evidence in support of Baylis' recommendations.

The repeated mention of definite per cent sand expansion by the advocates of the different methods of back washing filters indicates the desirability of a practical method and dependable instrument for measuring and indicating the degree of sand expansion. In our opinion it would be desirable to have a permanent record of the length of filter wash as well as the rate of wash water applied. It was this which prompted us to look into the perfection of method and equipment to attain that end. Hence the experiences which are now to be related.

Apparatus and Methods

An indicator was furnished by the Simplex Valve & Meter Co. and consisted of a dial graduated in inches, and an index pointer and pulley. A cone shaped sand-float, made after the specifications of Herring, was 14 inches in diameter and 4 inches high, the angle at the base being 25 degrees. Sheet lead for loading the float was attached to the base, with bolts. This cone also had a one-inch skirt projecting beyond the base. The specifications included six to eight 1/8th inch holes through float skirt to prevent trapping of air. The weight of float and counterweight was adjusted to allow the float to barely sink through the water. When this float was installed in one of our filters, it was immediately apparent that the angle of the cone was too shallow. The expanding sand lodged on the surface of the cone, and the additional weight of the sand caused the float to sink into the expanded sand to defeat the function of the instrument.

It was therefore necessary to design a new float with an angle somewhat greater than the angle of repose of the material in the filter. This float also had a base of 14 inches, but the angle at the base was 52 degrees. No sand was retained on the sloping surface of this cone. Since the float was then 9 inches in height it proved to be impractical. If the sand was expanded to within a distance of less than 9 inches of the trough overflow, the apex of the float protruded above the surface of the water and upset the balance of the counterweight attached to the float, and in reality lowered the freeboard. Working with this float in the large filter revealed, however, that the float method of measuring sand expansion seemed to be more accurate than the submarine light method and justified further study.

Experimental Filter Constructed

Since the object of this study did not necessitate the filtration of water, but was limited to back washing only, we found it convenient to convert an aquarium into an observation filter. This filter (see cut) had three sides of glass and one of wood, affording ample opportunity for observing the movement of the sand bed and float action during the wash. The wooden side made it convenient for introducing the ½-inch pipe and attaching a tin gutter to serve as a wash water trough. The half inch pipe in the bottom of the filter was in the form of a cross with the ends plugged. The bottom of the pipe was perforated with a sufficient number of 1/8-inch holes to correspond with the area of the pipe and a half inch valve was placed in the line, at a convenient place, for the control of the wash water. The inside dimensions of the filter are 6⅝ x 9⅘ x 41 inches.

The gravel in the filter is of the following sizes and depth, and is held in place by a fixed screen.

Three inch layer—size from ⅝ to ⅜ inch.

Two inch layer—size from ⅜ to 1/8 inch.

Two inch layer—size from 1/8 inch to 1/32 inch.

The depth of sand in the filter was limited to 20 inches in order to have a space of 13.5 inches from the settled sand bed to the wash water trough. The 13.5 inches of freeboard made it possible to expand the sand bed 60 per cent. The sand, zeolite and coal used in the tests were as follows:

Material	Source	Eff. Size	Unif. Coef.
Sand (9 yrs. in use)	Allentown Filters....	.64 mm.	1.30
New sand	Roberts Filter Mfg. Co.	.40-.45 mm.	1.60
Anthrafilt	Anthracite Institute..	.60-.75 mm.	1.60
Zeolite (greensand)..	Zeolite Sales Co.....		

EXPERIMENTAL FLOAT DATA—ALLENTOWN FILTRATION PLANT

Float Letter	Size of Float in Millimeters—Approx. Base	Height	Base Angle*	Vol. of Float in Ml.	Wt. of Float (in Water) in Gms.	Wt. of Counter-weight in Gms.	Specific Gravity of Float	Per Cent Counter-weight†	Material in Filter
A	78	50	51.4	79.2	101.2	88.05	2.263	87	Sand
B‡	78	34	40	....	.....	.....	....	...	.....
C‡	78	27.5	35	....	.....	.....	....	...	.....
D	78	40	45	70.9	118.51	106.37	2.671	89.7	Sand
E	100	50	45	153.6	44.9	27.23	1.29	60.6	Sand
F	100	50	45	147.2	61.67	40.44	1.418	65.6	Sand
H	100	50	45	147.9	86.67	63.67	1.592	72.6	Sand
I	100	50	45	142.0	108.55	92.0	1.764	84.8	Sand
K	100	50	45	147.9	119.81	105.65	1.809	88.2	Sand
L	100	50	45	145.3	183.33	168.85	2.262	92.1	Sand
M	100	50	45	151.9	152.8	137.62	2.005	90.1	Sand
N	100	50	45	130.5	159.9	143.94	2.226	89.9	Sand
O	100	50	45	154.7	159.5	145.49	2.03	92.9	Sand
P	100	50	45	139.5	182.4	163.97	2.308	89.9	Sand
						121.9	....	90.3	Sand
R	100	64	51.4	174.9	135.03	123.26	1.772	93.5	Coal
R	100	64	51.4	174.9	135.03	128.46	....	95.1	Zeolite

*Degrees sloping top to base. †Per cent of Cwt. $= \frac{\text{Wt. of Cwt.}}{\text{Wt. of Float in Water}}$. ‡Floats B, C—Angles at base proved too small.

Float Design Tests

The angle of repose for the expanded sand, coal and zeolite was determined by the use of floats with base angles of 35, 40, 43, 45, and 51.4 degrees. The 45 degree float proved satisfactory for the sands used in the tests, while a 51.4 degree float was required for the coal and zeolite.

The accompanying table shows the characteristics of the floats used in the experiment. These, with the exception of float A, were made with a convex base and stabilized by loading on the inside with lead. Float A was made with a ⅛-inch skirt at the base and loaded with sheet lead attached to the base.

During the tests with the model filter we found that, with a correct counterweight, the float followed the sand very closely and that when the specific gravity of the float is greater than 1.7, there was no tendency for the float to revolve or to be displaced sidewise during high velocity washing.

The graph (Fig. 1) shows the relation between the rise of the sand in inches as given by the indicator, and the exact rise of the sand as measured with a scale placed against the glass side of the filter.

It will be noted from these curves that if the counterweight is too light (i.e., the float is too heavy), that the rise as shown by the indicator dial gradually falls below the actual rise. This lag increases until finally the float sinks completely in the sand. It is also shown that if the counterweight is too heavy (i.e., the float is too light) that the rise as shown by the indicator dial gradually increases above the actual sand rise until a point is reached when the float rises completely above the sand and remains in suspension as the wash water approaches maximum.

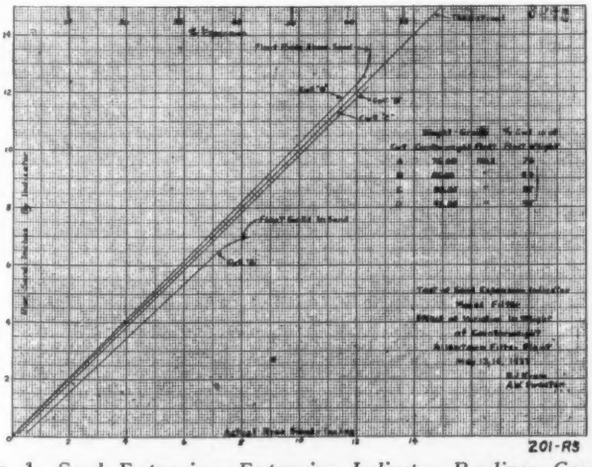


Fig. 1—Sand Expansion—Expansion Indicator Readings Compared Against Scale Measured Expansion.

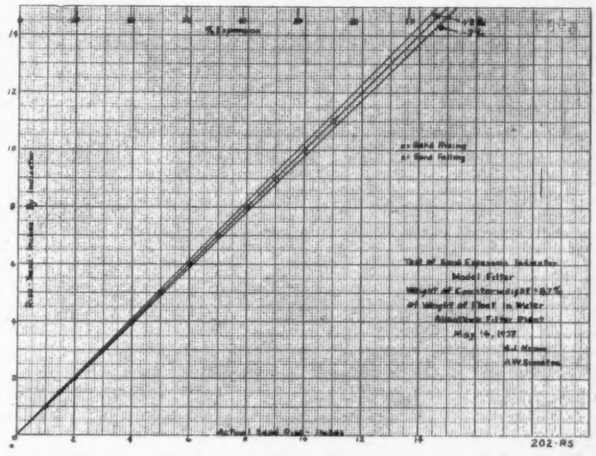


Fig. 2—Accuracy Tests—Showing Range and Accuracy of the Float Design Selected.

The table on the graph sheet shows the actual weights of the counterweights and the weight of the float in water, as well as the percentage that the counterweight is of the float weight. From the graph and table, it is clear that the best agreement is obtained when the counterweight weighs approximately 87 per cent of the float weight.

A second graph (Fig. 2) reveals the tests made with the 87 per cent counterweight. In it will be noted that no readings have an error greater than 2 per cent, plus or minus. This graph also shows the degree of lag of the float, since the test was made by increasing the washing rate to better than 60 per cent bed expansion and then decreasing the washing rate gradually to zero.

All of the tests indicate that the "Sand Expansion Indicator" developed at Allentown with the cooperation of the Simplex Valve and Meter Co., seems to represent a wholly satisfactory device for actually measuring the sand expansion. Tests with the model filter indicated

that the submerging-light method of determining the sand rise was less dependable, or exact, and involved a personal equation.

Most of the tests were made with 62 deg. F. wash water. However, identical results were obtained when temperatures were 40 and 80 deg. F. in less extensive tests.

The table of float design data reveals that the correct counterweight for sand with float (R) was 90.3 per cent of the weight of the float in water. With the same float, when coal was used in the filter, it was 93.5 per cent; and, for zeolite (greensand), 95 per cent. This shows that for any marked departures in the specific gravity of the material in the filter there exists a definite effect on the relation of weight of float to weight of counterweight.

Summary

Authorities quoted appear to be washing filter beds at a per cent sand expansion which is considered most economical and efficient in their plants.

A simplified and practical instrument—the "Sand Expansion Indicator"—consisting of a float, counterweight and indicator, for indicating the actual filter bed rise, has been developed and is described.

It is shown that the indicator is accurate, and the float stable, irrespective of the particle size and gravity of the filtering medium, water temperature or depth of flood.

The process of filter washing, by any group of operators working with the same beds, seems capable of greater standardization with higher dependability, when guided by a sand expansion indicator, rather than valve opening or velocity rise of wash water.

Acknowledgment: The authors desire to acknowledge the valuable services rendered by Mr. Sweeten, Experimental Engineer of the Simplex Valve & Meter Co., in the tests, and also in the preparation of this paper.

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"Old Dominion" Section to Do Honor to Virginia's President of A.W.W.A.

From Marsden Smith, director of the Virginia Section of A.W.W.A., comes a brief announcement concerning the program arranged for the annual meeting of the Section to be held in the capital city of the "Old Dominion," November 4 and 5.

Proud of its President of A.W.W.A., the Virginians are planning special things in honor of "Gene" Dugger. They are also arranging their meeting so that those attending will have opportunity to visit historic Williamsburg—the restored Capital of the Colonies. [Incidentally, Williamsburg is only about eight miles distant from the plant of the Newport News Water Works, of which Mr. Dugger is manager.—Ed.]

The program has not been released at this writing, but take Marsden Smith's word for it, that it is to be "different," less technical and less crowded than heretofore, with more opportunity for varied discussion and roaming around the balcony exhibits of manufacturers equipment, and the lobbies of famed and plutocratic Hotel Jefferson. On November 6 the Virginia Tech. vs. University of Richmond football game adds an attraction. So, says Marsden Smith:

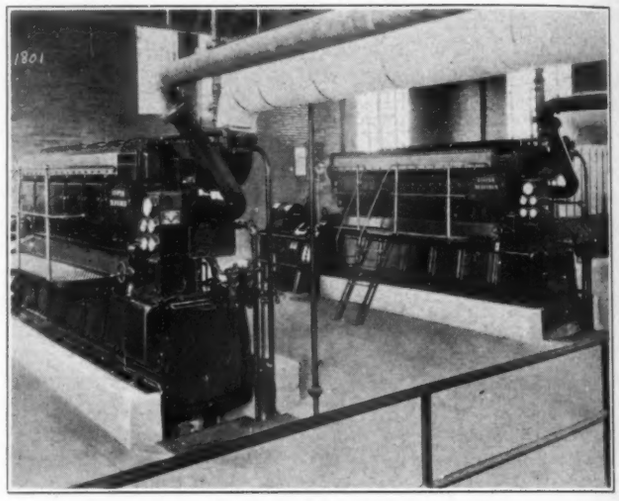
"Come to Richmond November 4, and we'll show you something different—something old, something new! The weather should be perfect and the roads too."

▼

Diesels Save Connersville $31.80 Per Day

The Water Department of Connersville, Ind. (about 12,000 population) is saving $31.80 a day, according to reported figures, since installating two new Diesel-generator sets for pumping its water supply. Likewise, a reduction in fire insurance rates is anticipated as a result of pumping improvements and strengthening of the service.

The accompanying picture shows the new Cooper-Bessemer Diesels (363 H.P. at 400 r.p.m.) and the



The Pride and Joy of Connersville Water Department. [A New Pump Station Powered by a Twin Installation of Diesels.

direct-connected 250 K.W. generators to Connersville's new plant.

With much satisfaction, Connersville officials point out that purchased electric power previously averaged $46 per day; whereas, the total daily cost of operating the new plant—including labor, overhead, and estimated depreciation—is $14.20 a day. Connersville's experiences are cited as another "case history" which emphasizes what Diesel power is accomplishing in water works operation.

So successful has been the early operation of the plant, that a project involving additional units, to produce current for street lighting, is under consideration.

▼

F. J. MacMullin Passes

Frederick J. MacMullin, manager of the Atlanta plant of Paper Makers Chemical Division of Hercules Powder Company, died September 16, following a cerebral hemorrhage. He was 44 years old at the time of his death. His body was taken for interment to his native city, Watertown, N. Y.

Mr. MacMullin was well known to water works men in the southeastern states, having been engaged in the manufacture and supply of water purification chemicals for ten years. He was an active member of the American Water Works Association and was deeply interested in the affairs of the Southeastern Section since its formation in 1929.

A FULLY AUTOMATIC SOFTENING AND IRON REMOVAL PLANT

Supplies Cuyahoga Falls, Ohio, Water to Meet the Taste—and the Pocketbook

By R. F. MacDOWELL[1] and H. L. BEOHNER[2]

THE City of Cuyahoga Falls, Ohio, has recently placed in operation a combination iron removal and zeolite water softening plant. It has the distinction of including the first fully automatic control equipment of its type installed for a municipal water treatment plant. The project constitutes an example of a complicated municipal improvement which was successfully constructed with WPA work relief labor.

This article is being written with the thought that the special features of the design may prove of interest to engineers and public officials designing, or contemplating, plants to remove the hardness or iron from public water supplies.

Cuyahoga Falls, with a population of about 22,000 in 1935, is located in Summit County, Ohio, adjacent to the City of Akron. It is largely a residential community although it has several medium size industries. Its water supply is taken from several drilled wells, four of which are normally in use. Each well is equipped with a separate motor-driven deep well pump.

The Cuyahoga Falls water works was built in 1921 and includes a modern pumping station with motor driven centrifugal high service pumps. The well water has an average hardness of 16 grains per gallon (274 parts per million) and an iron content varying, in the different wells, from 0.4 to 2.0 parts per million.

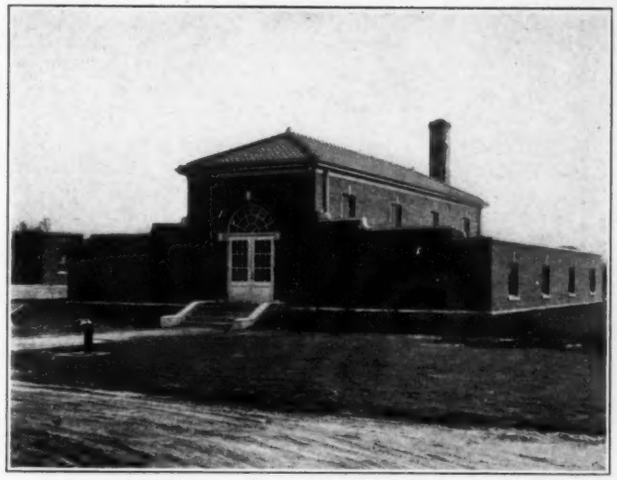
An iron removal plant was constructed in 1924 and consists of a coke aerator, a plain sedimentation tank, and two gravity mechanical filters. This plant, though of fairly satisfactory design, was of inadequate capacity during periods of peak consumption. An increasing demand for soft water arose, due to the modern developments in the art of municipal water softening. Likewise, due to the fact that there have been so many municipal softening plants installed in Ohio which, by the way, leads all of the states in this regard. Finally, after making preliminary studies and estimates of cost, an application was submitted to the Federal Works Progress Administration late in 1934 and an allocation was secured to materially assist in the financing of the project.

The Plant

Type and Capacity

In the preliminary studies three methods of softening were considered; namely, lime-soda, pressure zeolite and gravity zeolite. These studies showed that, under the conditions at Cuyahoga Falls, the lime-soda method would be more expensive than either type of zeolite plant from the standpoint of construction cost as well as the cost of operation. Despite a somewhat higher initial cost, a gravity-zeolite plant was selected over the pressure zeolite type, as offering more labor cost for construction which was attractive not only to WPA but to the local authorities.

[1]Consulting Engineer, Cleveland, Ohio.
[2]Sanitary Engineer, The Permutit Co., New York City.



Cuyahoga Falls Water Softening Plant.

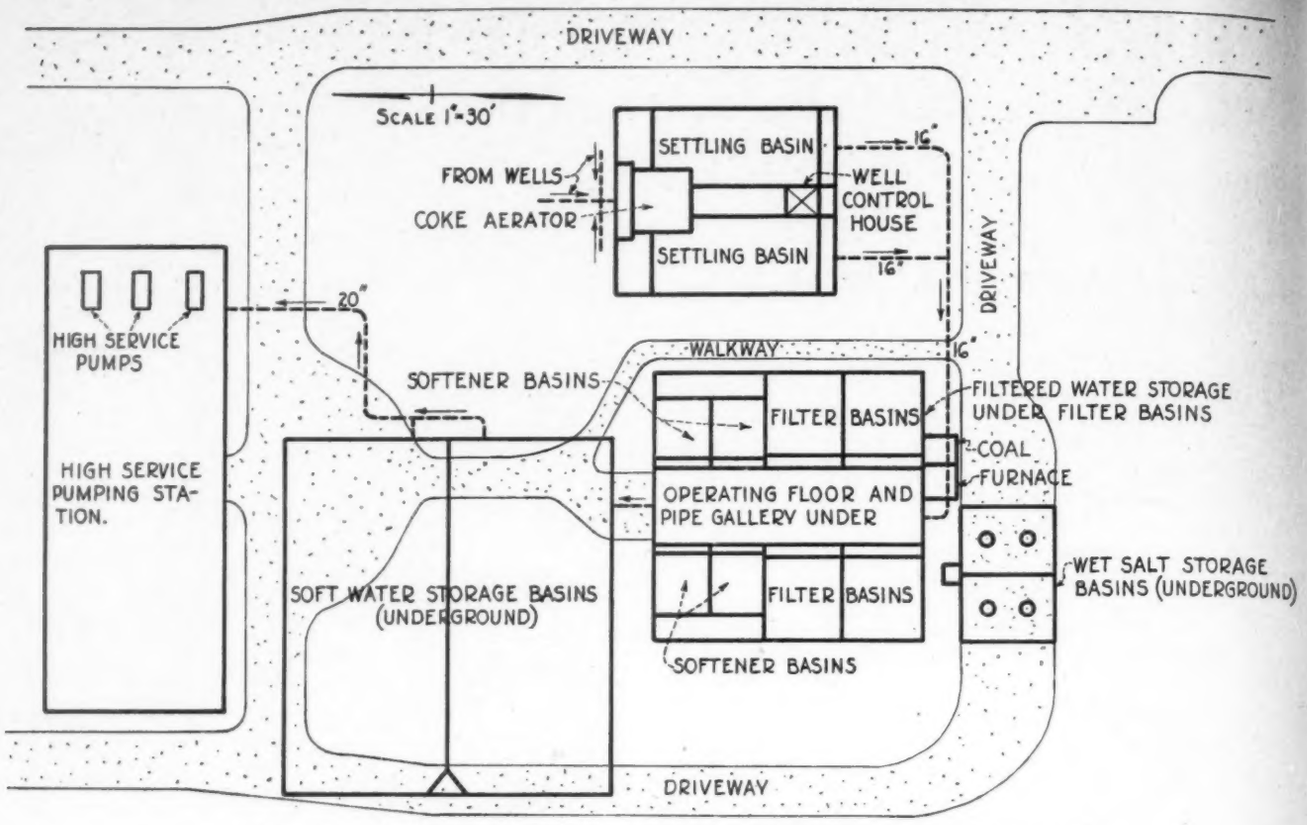
The plant was designed to provide a capacity to soften and remove the iron from 4 million gallons of water per day but in order to save initial cost the piping, the control equipment and filtering medium were omitted from one filter and one softener unit. The present capacity of the plant is therefore 3.0 mgd. which is safely above the present maximum daily water consumption of about 2.4 mgd. The new plant consists, in general, of improved aeration; additional settling basin capacity; semi-automatic gravity mechanical filters for iron removal; automatic gravity zeolite softeners, to reduce the hardness to about 4½ grains per gallon; enlarged underground hard water storage; and underground soft water storage basins.

Aerator and Settling Basin

The aerator, mounted over the inlet end of the settling basin, is of the coke tray type. It is constructed of steel with V-notch weir distributing troughs and 3 coke trays, each of the latter having 100 sq. ft. of area. The two concrete settling basins with baffled inlets and submerged port outlets have a total detention period of 45 minutes at a flow of 4.0 mgd. This capacity was provided by raising the walls of the existing settling basin and providing an additional basin adjacent to the old one. Concrete baffles across the basins near the inlet end, which extend to within 1 ft. of the bottom, provide an even distribution of the flow to reduce short circuiting in the basin. Gates are provided in the inlet flumes so that either half of the basin may be removed from service independently for cleaning. The outlet is through submerged ports across the end of an effluent channel and thence to the main filter influent pipe leading to the filter building.

Automatic Well Control

Mounted in a small building, over the outlet end of the settling basin, is a float operated cam switch of



General Plan, Cuyahoga Falls Combination Iron Removal and Fully Automatic Softening Plant.

Electric Controller & Manufacturing Co. make, giving automatic selective control of the starting and stopping of the deep well pumps, so as to maintain a constant water level in the settling basin at an elevation sufficient to feed the filters by gravity. Hand controls, on a panel in the operating gallery of the filters and softeners, permit the operator to maintain in service any desired number and combination of wells.

Filters

From the settling basin the aerator and settled water passes by gravity to 3 semi-automatic gravity type mechanical filters of modern design. Each filter has a capacity of 1.0 mgd. and is equipped with a strainer system consisting of cast-iron pipe headers and laterals, 2 cast-in-place concrete wash water troughs, Chapman hydraulic valves, Simplex (direct acting) rate controllers, Permutit loss-of-head gauges and Permutit semi-automatic operating tables, constructed of marble.

Softeners

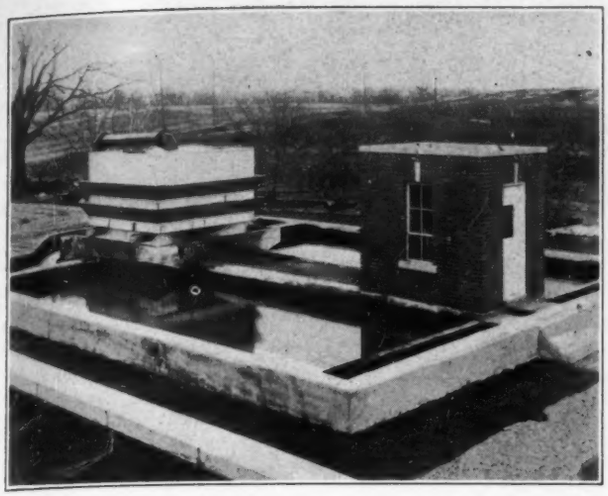
After passing through the filters the deferrized water drops into a hard water storage basin, of 70,000 gals. capacity, located beneath the filters. From this hard water storage basin the water is pumped upward through the softeners by means of four motor driven, centrifugal, transfer pumps, located in the pipe gallery. These pumps also serve for backwashing the filters.

Each automatic softener has a capacity of 1 million gallons per day, including by-passed hard water. The softeners are of the up-flow gravity type, using the synthetic zeolite, Permutit—Decalso. Synthetic zeolite was selected because of its high operating exchange value, low salt consumption and low waste water requirements. Although this zeolite is not as adaptable as the natural green sand for some waters, it could be used advantageously at Cuyahoga Falls where only clear hard well water, freed of iron, reaches the softeners. In order to provide efficient softening the softener basins were designed to require a depth of zeolite bed of 3.67 ft., at the same time providing ample basin depth to allow for bed expansion caused by the upward flow of the water through the zeolite while softening. Also the depth provided will permit a later increase of the volume of zeolite and, thereby, an increased softening capacity when required.

The determination of the size of the softening units, and the quantity of zeolite to be used offered an interesting economic problem of design. On the basis of the 4.0 mgd. plant capacity 3 regenerations per softener unit per day were determined to be the most economical, under conditions at Cuyahoga Falls. Fewer regenerations per day would have necessitated the use of more zeolite, while a larger number of regenerations would have involved too shallow a depth of zeolite since the area of the softeners was set by the flow rate through the plant.

A total of 408 cu. ft. of Decalso zeolite was required for each unit, or a total of 1,224 cu. ft. for the 3 softener units initially equipped. For the 110 sq. ft. of softener area in each unit, the softening rate is approximately 4.3 gallons per minute per sq. ft. The water required for rinsing was estimated as 20 gallons per cu. ft. of zeolite and the brining water at 3.5 gallons per cu. ft. requiring a total of 8,800 gallons of water per unit regeneration. This is approximately 2.65% of the total water pumped to service. The amount of common salt required per regeneration (based on the manufacturer's guarantee of 0.35 lbs. per kgr.* of hardness removed) is 6.0 tons per day for 3.0 mgd. total filtered and softened water delivered to service. Indications, however, are that actual amounts of salt required will be less than that guaranteed.

The softener units are equipped with a brine distributing system of chrome-nickel-iron pipes, placed above the



Aerator and Settling Basins, Cuyahoga Falls, Ohio.

surface of the zeolite; and, a chrome-nickel-iron distributing and collecting system, with cast iron strainers, located on the bottom of the basin. The chrome-nickel-iron selected is especially resistant to the brine solution. Concrete troughs similar to those in the filters are provided, together with hydraulic valves, Simplex (direct acting) rate controllers, Permutit automatic operating tables, and Permutit automatic regenerating control equipment. This control equipment is described in more detail later.

Table 1—DATA ON BASIS OF DESIGN OF ZEOLITE UNITS

Capacity of Softener Units—4.0 MGD of 16 gr. hardness, reduced to 5 grains. Four softener basins, each 1.0 mgd cap. (One unit at present not equipped.)
Design for 3 Regenerations per Day per unit.
Synthetic Zeolite, Exchange Capacity of 9 kgr. per cu. ft. Total Zeolite per unit = 408 cu. ft.
Softening Rate, 4.3 gals. per min. per sq. ft.
Guaranteed Salt Consumption, not over 0.35 pounds per 1,000 grains hardness removed.
Water Required for Regeneration:
Rinse Water—18 gals. per cu. ft. zeolite.
Brining Water—3.55 gals. per cu. ft. zeolite.
No Back Wash Water required as softening is up-flow.
Total—21.55 gals. = 8,800 gals. per regeneration = 2.64% of output.
Total Capacity, Wet Salt Storage (2 section basin)—60 tons at 60 lbs. salt per cu. ft.

Brine System

In order to permit the purchase of salt for regeneration of the zeolite in bulk carload lots, a concrete wet-salt storage basin is provided having a total capacity of 2 carloads, or 80 tons of salt at 60 lbs. per cu. ft. capacity. The basin is divided into two compartments by a cross wall so that each compartment, holding one carload of salt, may be filled while the other is being used. Each compartment is kept full of water by a float valve, and the saturated brine is taken from concrete domes in the bottom. These outlets are surrounded with gravel to keep out the undissolved salt.

A 160 gpm. bronze-lined brine pump, located in the pipe gallery, conveys the saturated brine to the softener unit. The brine is pumped through a meter where it is accurately measured and dilution water under pressure is then added before it is distributed over the zeolite. The brine meter is provided with an electrical contact which automatically stops the pump when the desired quantity of brine has been transferred.

Pipe Gallery

A pipe gallery extends along the entire width of the filters and softeners under the operating floor. It contains the filter influent, effluent, wash water and drain piping; the softener influent, effluent, bypass, drain and brine piping; the water pressure piping for operating the hydraulic valves, and the transfer and brine pumping units. Various control devices are also located in the gallery.

The pipe gallery (15 ft. wide) has ample passageway and is reached by means of a circular steel stairway from the center of the operating gallery, as seen in one of the pictures.

Superstructure

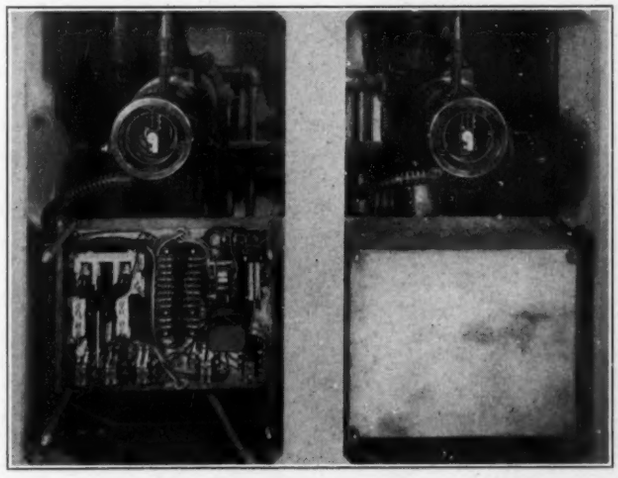
The superstructure, over the filter and softener basins, is constructed of red brick with a green tile roof. The interior of the operating gallery is finished with buff, glazed, brick tile and has exposed, ornamental, wood roof trusses. The floor is gray quarry tile. The Permutit automatic operating tables, of pink Tennessee marble with chromium trim, add a pleasing appearance.

The heating system consists of a steam boiler which is separately housed at the rear of the operating gallery. The steam is piped to two fan-operated unit heaters on the front and rear walls of the gallery. Flush, wall mounted type electric control and meter panels are recessed in the center of the side walls of the operating gallery, and opposite each other. An enclosed lighting control switch panel is recessed in the front wall. A metal unit sink and cabinet, with hot and cold water spigots, complete the equipment of the operating gallery. The pleasing general appearance of the operating gallery is revealed in the pictures.

Soft Water Storage

The effluent from the softeners flows by gravity to an underground, covered, soft water storage basin of 200,000 gallons capacity from which the high service pumps, located in the main pumping station, take their suction. The final effluent from the plant consists of a mixture of fully softened water with hard filtered water. The mixing is proportioned to secure a resulting hardness of 4½ grains to 5 grains per gallon in the water leaving the plant.

The softened water storage basin is divided by a cross wall to permit the draining of either half for cleaning or repairs. It is provided with float switches connected both to the transfer pumps in the pipe gallery and to the high service pumps in order to control the high and low water levels.



Doors Removed to Reveal the Interior Mechanism of the Double Softener Operating Table—The "Heart of the Works" Being the Multiport Valves Which Make Automatic Control and Regeneration of Beds Possible.

*1 Kgr. = 1,000 grains.

Cuyahoga Falls, Ohio, Water Softening Plant Operating Gallery, Looking Toward Front Door. (Filter Operating Table on Right; Softener Operating Table to Left.)

Control Equipment

The unique feature of the plant is the automatic and semi-automatic control equipment provided. Even though an operator is on duty in the pumping station and softening plant 24 hours per day it was felt desirable, in accordance with the modern trend, to make the operation of the plant as automatic as possible. This not only eliminated the necessity of the operator being in constant touch with all features of the plant, but it provided an accurate and economic control which is not possible with manual control, and precludes errors inherent to human operation.

Filter Control Equipment

The pleasing appearance of the top of the filter operating table shows in the pictures.

Double operating tables, each controlling two filter or softener units, are used to concentrate equipment and to improve appearance. The operations of the hydraulic filter valves on each unit are controlled from a single multiport pilot-valve located in the operating table. It is turned through proper gearing by a fractional horsepower motor. The manual control of the motor is located in the top of the operating table. Indicating dials showing the location of the multiport valve are also located on top of the operating tables. When the operator desires to wash a filter it is only necessary to depress the starter button on the corresponding unit until the indicator hand moves from "FILTER" to the "WASH" position. When the multiport valve is in the wash position the wash-inlet and wash-outlet valves on that unit are opened and all other valves on the unit are closed. To "rewash" or "filter to waste" it is only necessary to again press the motor starter button rotating the multiport valve to the "REWASH" position. Further energizing the multiport valve motor, rotates the valve again to the filtering position.

Electrical limit switches are provided at both ends of the travel of the tail rods of the hydraulic valves. These limit switches are connected to corresponding signal lights located on top of the operating table. Thus, the operator is able to observe at any time which valves are in the open or closed position. This gives a quick and positive check on the operation of the hydraulic valves.

Since the transfer pumps, which convey the filtered water to the softeners, are also used for backwashing the filters an additional contact is made when the tail rod of any wash inlet valve reaches the open position. The closing of this electrical circuit energizes a solenoid valve which results in the closing of a large hydraulic valve on the main inlet line to the softeners. Thus, the operator is insured an adequate and constant supply of wash water for the filters.

Additional safety controls are provided on the filters in case the water level rises too high in any filter or in the filtered water storage basin; or, in case the level of water in any filter tends to drain below the surface of the sand bed. In case the level rises too high in the filter basin a float controlled pilot valve throttles a hydraulic valve on the filtered water inlet; but, if the level drops too low a float switch energizes the multiport control valve of that filter to turn the control valve to the off position and removes the filter from service until the difficulty has been automatically remedied. When the level of water in the filtered water basin rises to the high water level all the filter multiport control valves are automatically turned to the off position where they remain until the operation of the transfer pumps again

reduce the level of the filtered water clearwell at which time all control valves are again automatically turned to the filter position.

Since the transfer pumps are operated automatically by the level of water in the soft water storage basin, the gravity filters go in and out of service automatically without any danger of draining the filter bed.

Softener Control Equipment

The softener operating tables, with their automatic control equipment, are similar in general appearance to the filter tables. No loss-of-head gauges are provided since the softeners operate as upflow units and handle only filtered water. The operation of the softener hydraulic valves is also controlled by a motor-driven multiport valve but no push button starter is required since the operation of the motor in this case is entirely automatic. A view of the interior of the double softener operating table with the doors removed, showing multiport valve and control equipment, accompanies this article.

All operations of the softeners are carried out automatically. Bailey (orifice-type) flow meters are installed on the main softener inlet line and the hard water bypass line. Rate of flow controllers on the individual softeners insure equal distribution of the softening load.

When an amount of water equal to the softening capacity of the three units has passed through the meter an electrical contact is made which initiates the regeneration of Softener No. 1. This energizes the small motor in the operating table, rotating the pilot valve to the brining position, at which point a circuit breaker connected to the pilot valve stops the motor. At the same time the brine pump motor is started. The proper hydraulic valves are opened by the pilot valve and the brine is pumped, metered, diluted and introduced into the softeners. When the correct amount of brine has been introduced the brine meter stops the brine pump and energizes the pilot valve motor starter, to rotate the pilot valve to the rinse position. The rate of rinsing is set by a Venturi rate-of-flow controller and the rinsing time is controlled by a Telechron motor. When the softener has been properly rinsed, the electric timer makes a contact which returns the pilot valve to its softening position. Then, just before it reaches the softening position, an additional contact is made which initiates the regeneration of Unit No. 2. Unit No. 2 is then brined, rinsed and returned to service and in turn the regeneration of Unit 3 takes effect.

When an amount of water, calculated on the basis of hardness removal capacity of the beds, has again passed through the meter another contact is made by the meter and the cycle repeats itself.

A safety device is provided on all softener units so that if the level in the softeners exceeds a predetermined high water level, a float rises, moving a 4-way pilot valve which closes the large hydraulic valve on the main softener inlet. It is this same hydraulic valve which is closed automatically whenever a filter is washed, thus serving a dual purpose.

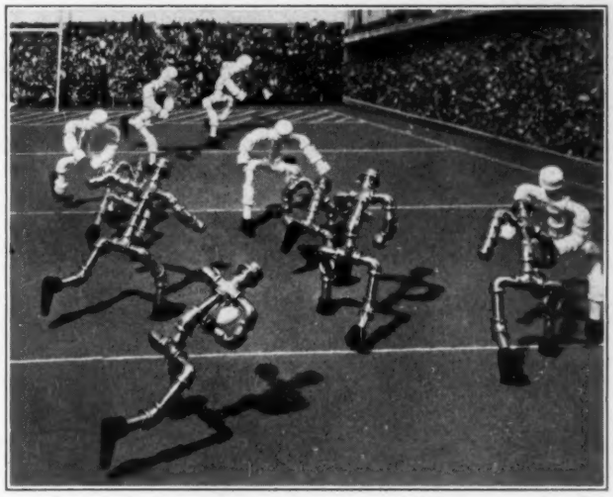
Acceptance of Plant

The new plant has been in operation for about seven months and comments on the character of water produced have been entirely favorable. Savings in soap and other washing compounds have more than pleased the citizens. Even the few "skeptics" who doubted the wisdom of the installation of the softening plant are now praising the character of the water produced. Cuyahoga Falls has thus been successful in installing one of the most modern water softening plants in the country.

"Men of Metal" Open Campaign

This photograph of the right side of the line shows Crane's "Men of Metal" in action. The unique display was set up by two former football players, now students in Crane Company's training school for graduate engineers.

From rubber feet (beer faucet-guards) to helmeted top, this aggregation of huskies are constructed from brass fittings and accessories selected from the stock of Crane Co. The seasonable display, in effective setting, is touring the country for display in cities where outstanding football games are being played, closing the



"Men of Metal" Open Campaign

season in Los Angeles with the Rose Bowl classic in Pasadena. If Crane's fittings block corrosion like Crane's "Men of Metal" are blocking the "White Threats" it's a "lead pipe cinch"—only, it's a "brass pipe cinch" in this case. And, we bet that many a football player will wish he had "Crane elbows" before the season closes.

▼

Wolman to Head A.P.H.A.

First Engineer President of Association Since the Late and Eminent George W. Fuller

Abel Wolman

Just sufficient time and space is available in this issue, now ready for press run, to flash the news to readers of WATER WORKS AND SEWERAGE, and the many admirers of Abel Wolman, that the Governing Council of the American Public Health Association, meeting in annual convention in New York City, Oct. 5th-8th, elevated him to President-Elect of the Association. In 1938 he automatically became its President—the first engineer member of this world renowned association of Public Health Officials to be thus honored since another engineer-leader, the late George W. Fuller, served as its president.

To Abel Wolman—recently made Doctor of Engineering by Johns Hopkins University, and more recently selected to lead his *alma mater's* Department of Sanitary Science—we are happy over the deserved recognition. To A.P.H.A.'s Council, our congratulations on the choice so wisely made!

TWELFTH ANNUAL MICHIGAN CONFERENCE ON WATER PURIFICATION*

By RAYMOND J. FAUST

THE Conference was welcomed to Muskegon by its genial Mayor, Mr. George D. Vanderwerp. By word and action the city did many things to assure the Conference of a pleasant, comfortable, and enjoyable time.

The official registration showed an attendance of 91.

John F. Norton, Director of Laboratories, The Upjohn Company, Kalamazoo, Michigan, in his paper, "Gastro-Enteritis and Its Relation to the Public Water Supply," reviewed the possible but, as yet, undefined causes of such outbreaks. Mr. Norton summarized his opinions by emphasizing "first, that the time is ripe for a reconsideration of drinking water standards; second, that it is still necessary to improve some of our laboratory control methods—in particular, the tests for chlorine and for the coliform group; and third, I urge you to take this question of gastro-enteritis, the method of spread and its relation to public water supplies, as a serious problem which warrants your most careful consideration."

Springfield's Unusual Plant

Mr. Charles H. Spaulding, Superintendent of Water Filtration, Springfield, Illinois, presented a most interesting paper on "Operating Results at Lakeside Water Softening Plant." The paper dealt with the unusual features of the new plant which he considers improvement of customary designs.

The unusual features of the Springfield plant are many and they will be merely mentioned without comment. Rate of filtration is four gallons per square foot per minute; wash water troughs are omitted from the filters; the filter sand size is slightly larger than 1 mm. in diameter; filter surface crusts are broken up by a water jet from a hose which requires no more than three minutes per filter. Wash water rates are as high as 45 inches rise per minute which, however, provides only a few inches of sand expansion. The free board between the sand surface and the top of the wash water gullet, which divides each filter at the middle, is 15 inches and this Mr. Spaulding finds too great and it will be reduced by the addition of more sand. The filtration rate is regulated by a master control rather than by individual controls on each filter; operating tables are omitted, small switchboards mounted on columns taking their place. All treated water flows in open concrete channels rather than in pipes. A rather unusual feature of the plant are the three "precipitators" each of which has a rated capacity of 6,000,000 gallons per day. The plant, ever since it has been in service, has produced excellent results which is satisfactory proof that the features outlined are sound.

Then came a paper by Raymond J. Faust, Assistant Engineer, Michigan Department of Health, Lansing, Michigan, who reviewed his experiences while performing flood duty in Southern Indiana for a period of one month, starting on January 29, when the Ohio River flood reached its crest.

The evening program consisted of a Fish Fry and Smoker at which Harry Lewis, Muskegon city engineer, was toastmaster. A moving picture entitled "The Water Works Man Pursueth the Villain" was shown and outlined the accepted methods for making threshold odor tests.

Round Table

The morning session on September 14 consisted of Round Table discussions on six subjects having local interest in Michigan. These subjects were "100 ml., E. Coli Plantings," "Chlorination of the Mains," "Paints in Water Treatment Plants," "Caustic Soda in Water Softening," "Progress Report of Threshold Odor Values," and "Michigan's Operator's License Regulation." Time was not adequate for full discussion on any of these subjects. Concerning the 100 ml. E. Coli Plantings, it is of interest that two filtration plants, Wyandotte and Bay City, made such plantings over a period of six months and reported their findings to the Conference. The conclusion was that the larger samples were of value but that the study should be continued and a further report be made in 1938.

The Michigan Water Works License Regulation was passed in 1931. After six years, the Conference feels that certain changes are desirable and a committee of five members was appointed to study the short-comings of the regulations and report to the 1938 Conference.

At the banquet, attended by 84 people, Harry E. Jordan, Secretary of the A. W. W. A., was the guest speaker. In his talk he pointed to the need for and value of a proposed Michigan Section of A. W. W. A.

Stream Pollution

On the final day of the Conference, September 15, three major papers were given. The subject "Progress Made in Elimination of Stream Pollution Since 1929" was divided into two parts—"Sewage Waste by W. F. Shephard, Assistant Engineer, Michigan Department of Health, and "Industrial Waste" by L. F. Oeming, Assistant Engineer, Michigan Stream Control Commission. Mr. Shephard explained the tremendous increase in the number of sewage treatment plants built in Michigan since 1929 and attributed this growth to Federal aid and sound state legislation which permitted towns to avail themselves of this aid. In 1929, 38 municipalities were served with sewage treatment plants and at the present there are 92 municipal and 36 institutional plants operating. The population now served is approximately 2,700,000 as against 448,000 in 1929. A total population of 3,500,000 people in Michigan are tributary to sewers.

Officers

At the business session the following members were elected:

R. L. Sensabaugh, Muskegon—Chairman
James Parks, Detroit—Vice-Chairman
Raymond J. Faust, Lansing—Secretary-Treasurer
Harry McEntee and William Russell—
Members of Executive Committee.

The meeting place for the 1938 Conference was not decided upon. During the afternoon an inspection trip was made to the Muskegon filter and sewage treatment plants, Muskegon Heights sewage treatment plant, Grand Haven's water and sewage treatment plants, and to the U. S. Coast Guard Cutter Escanaba.

*This report is possible through the courtesy of Raymond J. Faust, Sec'y-Treas. of the Michigan Conference.—Ed.

FLOCCULATION STUDIES*

Made in Connection With Treatment of Packing House Waste at the Combination Plant of Cedar Rapids, Iowa

By HOWARD R. GREEN and J. C. McINTYRE

Consulting Engr.; Supt. Treatment Wks., Cedar Rapids, Iowa.

In the June 1937 issue of WATER WORKS AND SEWERAGE *is to be found an article by the senior author of this article. Mr. Green's earlier article constituted a brief description of the unique and pioneering Combination Wastes Treatment Plant of Cedar Rapids. It also contains a review and discussion of operating experiences and results attained during the first year of plant operation.*

The present article revealing the results from "Flocculation Studies," with and without the aid of chemicals, constitutes a follow-up article from Mr. Green to amplify and bring up to date what is being learned at this unique combination treatment plant designed by him and built and operated as a municipal plant by Cedar Rapids. Herein the value of mechanical flocculation without the aid of chemicals is well shown. The results with packing house wastes at Cedar Rapids exceed those procured elsewhere with domestic sewage.

In a forthcoming follow-up article, by Messrs. Green and McIntyre, experiences with gas recovery and gas-engine operation as a source of power production at Cedar Rapids will be revealed.

DURING the past year and a half almost continuous studies have been made of the effect of flocculation of packing house wastes at the Cedar Rapids Municipal Disposal Plant. The purpose of these studies was to determine the most economical method of reducing the suspended solids in the packing house wastes to an acceptable minimum prior to mixing the same with clarified city sewage preparatory to application of the mixed wastes to standard trickling filters for secondary treatment. Various types and dosages of coagulants and various routes of flow through the plant were experimented with and are reported here.

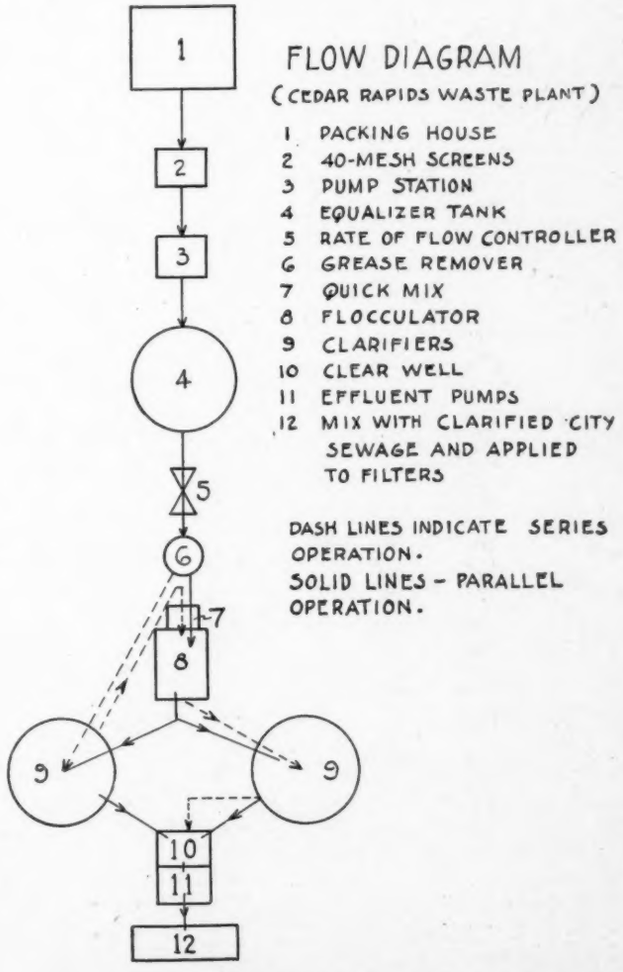
Description of Plant

During 1936 a daily average of 800,000 gallons per day of trade waste was passed through the plant. The material had a B.O.D. of 681 P.P.M. and suspended solids averaging 526 P.P.M. Before delivery to the city sewer the packing waste passed through standard gravity type grease removal units and through a pair of 40 mesh revolving screens. The resulting liquid was pumped by an automatic station to the city owned pre-treatment plant at the site of the general disposal works. Because the rate of delivery of the waste varies materially from hour to hour, a 360,000 gallon capacity storage reservoir was constructed as the first unit of the pre-treatment plant. The rate of flow of sewage through the plant is thereafter automatically governed by a standard rate of flow controller. The sewage is next passed through a cone and cylinder type of air blown grease remover, and from this unit its flow is through a radial-flow type of clarifier, thence to a quick-mix unit where coagulants may be added, thence through a 4-paddle flocculator to a second similar clarifier from which the effluent is automatically pumped to mix with the clarified city sewage. Or at the will of the operator the sewage may be flocculated and, then, the flow divided to pass through the clarifiers in parallel. The control house is equipped with displacement type sludge pumps, so connected that secondary sludge may be returned to the flocculator, into the primary clarifier, or to the digestion tanks. Chemical dosing equipment includes both wet and dry feeders so that practically any desired combination of coagulants or materials for pH control may be handled.

*A follow-up article to that by Mr. Green, in the July 1937 issue, which describes the unique Cedar Rapids Combination Wastes Treatment Plant, and cites results during the first year of operation.

Plan of Studies

The studies were not conducted with the idea of substantiating any preconceived notions as to the method of treatment. It was assumed in designing the plant that the use of chemical precipitation would provide a flexibil-



ity in degree of treatment which was very much to be desired in view of the ever increasing load thrown upon the plant. It is anticipated that as this load increases from year to year the use of heavier dosages of coagulants might make possible a heavier volumetric loading upon the plant, and therefore delay the necessity of expansion of the physical units. Therefore, all the studies were conducted under actual operating conditions, taking the volumes and concentrations as they occurred from day to day and controlling only the method and rate of treatment. The concentration of the waste, both in terms of B.O.D. and settleable solids, varied so materially that the results of the tests have been subdivided into three groups as will be noted. Extreme variations from the normal results have been eliminated from the tables, and it is believed that the averages shown represent what may normally be expected under the indicated conditions.

Table 1 shows the detailed results of a long run conducted without the use of coagulants. The sewage was given a 100 minute detention period in the first clarifier; it was then flocculated for 35 minutes without chemicals and passed to the second clarifier for a 100 minute detention period. The overflow rate in each clarifier was 733 gallons per square foot of area per day. The floc developed compared favorably with that procured by the addition of coagulants at the dosages used, and it will be noted that the removal of suspended solids approximated 71 per cent, 75 per cent, 77 per cent for the weak, medium and strong sewages respectively. The B.O.D. reduction on these three classes of sewage approximated 30 per cent, 33 percent, 41 per cent respectively.

Table 2 indicates the results of a considerable run using no coagulants but passing the unsettled wastes directly to the flocculator and thence through the two

TABLE 1

No Chemicals Used.
Settled 1⅔ hr.—Flocculated 35 min.—Settled 1⅔ hr.
Overflow Rate 733 G./sq. ft./day.

B.O.D. 400 to 700					B.O.D. 700 to 1000					B.O.D. 1000 to 1500				
pH Raw	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.	pH Raw	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.	pH Raw	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.
6.9	...	626	...	20.3	6.8	526	912	69.0	39.0	7.0	960	1447	86.7	51.8
7.0	474	692	67.3	28.9	6.7	536	786	74.1	34.1	6.9	...	1457	...	43.9
7.0	492	631	77.8	30.4	6.5	476	925	58.6	19.8	6.9	822	1284	85.3	42.7
6.9	471	589	74.9	28.5	6.9	...	735	...	44.1	7.1	694	1500	68.7	33.6
6.9	495	663	75.4	39.8	6.9	...	778	...	32.5	6.7	660	1490	63.6	40.5
6.8	416	531	69.0	10.4	6.8	930	829	82.4	44.8	6.8	820	1127	76.5	50.1
6.7	600	696	75.8	25.6	6.8	...	761	...	30.9	6.8	920	1247	83.8	44.8
6.9	550	441	77.1	26.3	6.8	580	777	70.7	21.5	6.9	618	1103	79.6	37.8
6.9	506	580	75.3	33.4	6.9	760	773	85.1	47.2	7.0	496	1027	75.4	36.5
6.9	...	601	...	35.3	6.9	542	800	67.3	18.0	6.8	776	1363	79.8	31.8
7.0	...	592	...	41.2	6.9	496	710	72.2	31.0	6.9	500	1013	67.4	39.9
7.1	394	400	58.9	23.1	6.7	770	876	76.6	28.8	..	...	....	...	...
7.0	434	574	74.7	35.7	6.8	710	870	78.3	33.1	..	...	....	...	...
6.9	424	562	74.1	42.0	6.9	630	757	76.8	33.0	..	...	....	...	...
7.1	499	492	68.2	17.6	7.2	354	722	78.8	37.8	..	...	....	...	...
6.8	460	511	70.0	36.8	6.9	712	877	81.2	48.7	..	...	....	...	...
7.0	572	642	72.7	49.2	6.9	628	767	77.1	29.6	..	...	....	...	...
7.2	...	648	...	37.2	6.7	676	867	77.8	28.3	..	...	....	...	...
7.1	404	442	64.4	29.0	..	...	...	...	...	..	...	....	...	...
7.1	...	647	...	35.4	..	...	...	...	...	..	...	....	...	...
7.2	380	550	52.9	15.6	..	...	...	...	...	..	...	....	...	...
7.0	710	640	76.2	12.2	..	...	...	...	...	..	...	....	...	...
Avg.	490	580	70.8	29.7		622	807	75.1	33.5		727	1278	76.7	41.2

TABLE 2

No Chemicals Used.
Flocculated 30 min.—Settled 3 hrs.
Overflow Rate 440 G./sq. ft./day.

B.O.D. 400 to 700					B.O.D. 700 to 1000					B.O.D. 1000 to 1500				
pH Raw	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.	pH Raw	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.	pH Raw	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.
6.8	390	645	69.0	32.9	6.9	508	710	72.6	32.3	6.8	870	1193	82.0	52.4
6.9	540	667	77.0	34.0	6.7	524	734	74.6	31.9	6.9	816	1103	84.6	44.9
7.0	600	633	79.8	41.9	6.8	552	720	70.3	15.4	..	...	....	...	...
6.9	456	593	73.0	25.1	6.7	524	814	74.6	27.4	..	...	....	...	...
7.3	474	685	79.7	38.0	6.6	...	779	...	29.0	..	...	....	...	...
7.0	340	533	78.8	22.0	7.0	554	773	67.5	40.5	..	...	....	...	...
7.1	650	533	82.6	39.6	7.0	774	797	81.5	40.0	..	...	....	...	...
7.2	618	550	76.1	40.0	7.0	530	807	73.2	33.6	..	...	....	...	...
6.9	370	477	76.2	46.3	6.9	722	857	89.5	58:2	..	...	....	...	...
7.0	640	693	81.7	43.4	7.1	...	897	...	52.5	..	...	....	...	...
7.1	670	683	78.4	29.7	6.8	630	750	80.2	37.6	..	...	....	...	...
6.9	610	412	78.4	30.1	6.9	730	730	84.9	40.3	..	...	....	...	...
6.9	540	660	78.7	40.0	..	...	....	...	...	..	...	....	...	...
6.9	460	498	79.3	42.0	..	...	....	...	...	..	...	....	...	...
6.9	460	550	80.7	37.1	..	...	....	...	...	..	...	....	...	...
7.2	480	638	81.3	53.0	..	...	....	...	...	..	...	....	...	...
7.4	492	475	81.5	48.0	..	...	....	...	...	..	...	....	...	...
7.3	...	446	...	51.3	..	...	....	...	...	..	...	....	...	...
7.1	...	470	...	29.8	..	...	....	...	...	..	...	....	...	...
7.0	...	416	...	23.6	..	...	....	...	...	..	...	....	...	...
Avg.	517	563	78.4	37.4		605	781	76.9	36.5		843	1148	83.3	48.7

TABLE 3

$FeCl_3$ and H_2SO_4 Added to Flocculator
Settled 1⅔ hr.—Flocculated 35 min.—Settled 1⅔ hr.
Overflow Rate 733 G./sq. ft./day

B.O.D. 700 to 1000					B.O.D. 1000 to 1500				
pH Raw	H_2SO_4 gr./gal.	$FeCl_3$ gr./gal.	B.O.D. Raw	% Red B.O.D.	pH Raw	H_2SO_4 gr./gal.	$FeCl_3$ gr./gal.	B.O.D. Raw	% Red B.O.D.
7.0	3.5	1.2	742	30.3	6.8	4.4	1.0	1180	48.7
6.8	4.1	1.5	734	38.4	6.9	5.0	1.5	1108	57.8
6.9	4.6	1.5	779	41.3					
Avg.	4.1	1.4	752	36.6		4.7	1.2	1144	53.2

TABLE 4

$FeCl_3$ Added to Flocculator
Flocculated 30 min.—Settled 3 hrs.
Overflow Rate 440 G./sq. ft./day

B.O.D. 400 to 700						B.O.D. 700 to 1000						B.O.D. 1000 to 1500					
pH Raw	$FeCl_3$ gr./gal.	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.	pH Raw	$FeCl_3$ gr./gal.	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.	pH Raw	$FeCl_3$ gr./gal.	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.
6.8	2.2	450	664	72.0	36.9	6.8	2.5	...	982	...	24.4	6.7	1.8	618	1114	72.3	51.6
6.8	2.2	...	700	...	31.1	6.9	2.4	582	816	72.3	31.0	6.8	2.4	634	1012	76.0	40.0
6.9	1.7	...	567	...	29.3	6.8	0.7	...	812	...	22.4	..	..	...	...	...	...
6.8	2.3	644	572	80.9	37.9	6.8	1.6	612	825	75.2	40.7	..	..	...	...	...	...
Avg.	2.1	547	626	76.4	32.3		1.8	597	859	73.7	29.6		2.1	626	1063	74.1	45.8

TABLE 5

$FeCl_3$ Added to Flocculator
Settled 1⅔ hrs.—Flocculated 35 min.—Settled 1⅔ hrs
Overflow Rate 7333 G./sq. ft./day

B.O.D. 400 to 700						B.O.D. 700 to 1000					
pH Raw	$FeCl_3$ gr./gal.	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.	pH Raw	$FeCl_3$ gr./gal.	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.
6.9	2.6	582	677	74.7	33.4	6.8	2.5	672	854	75.3	43.9
6.7	1.6	480	480	73.0	30.8	6.7	1.1	...	978	...	39.5
6.7	1.7	610	617	72.5	43.9	6.7	1.6	496	752	65.7	24.2
6.9	1.7	576	660	72.7	47.6	6.7	1.6	630	917	77.8	52.7
6.8	2.1	520	686	72.9	39.6	6.9	1.7	550	724	79.5	42.1
6.9	2.0	392	539	63.5	29.9	6.8	2.0	546	711	66.5	24.8
6.9	1.2	470	652	45.1	10.1	..	..	...	...	...	...
6.8	2.1	452	508	71.7	20.5	..	..	...	...	...	...
6.8	2.0	528	568	73.3	48.8	..	..	...	...	...	...
7.0	1.0	...	528	...	24.6	..	..	...	...	...	...
Avg.	1.8	512	591	68.8	32.9		1.7	579	822	71.9	37.9

clarifiers in parallel. This produced a 180 minutes detention period in the clarifiers and yielded an overflow rate of 440 gallons per square foot per day. Under this system the removal of suspended solids was 8 per cent better on weak sewage, 2 per cent better on medium and 7 per cent better on strong sewage. The B.O.D. removal was 7 per cent, 3 per cent and 7 per cent better respectively. Inasmuch as the time of flocculation was 5 minutes shorter during this second test, the advantage of a longer detention period in the clarifiers is apparent.

Table 3 shows the results of the third run during which the pH of the waste was reduced to the approximate neutral point with sulphuric acid, and ferric chloride in moderate doses used as a coagulant. It will be noted that the removal of B.O.D. was substantially identical so far as medium waste was concerned, but that a beneficial effect was noted when higher concentrations of wastes passed through the plant. During this test series operation sequence was followed as in Test 1.

The test noted in Table 4 eliminated the use of sulphuric acid and passed the sewage through the clarifiers in parallel after flocculation. Apparently no beneficial results were noted as compared with a similar routine in Test 2 where no chemicals were used.

Test 5, which was conducted for a longer period, used ferric chloride as a coagulant and passed the sewage through the clarifiers in series. The results indicate that the removal of settleable solids on weak and medium sewage was not up to the results obtained in Test 1 where a similar routine, but no coagulants, was used. The removal of B.O.D., however, was about 4 per cent better in both cases.

Table 6 reports upon an extended run using lime as a flocculating agent and passing the sewage through the clarifiers in parallel. An excellent appearing floc was developed in this case but the B.O.D. removal was inferior as compared with Test 2 where no chemicals were used and a similar routine was followed.

Lime was added to the flocculator and sedimentation was in series in Test 7. Results were better than in Test 1 so far as weak and medium strong sewage was concerned, but were practically identical on the single day when a strong sewage reached the plant.

In Test 8 ferric chloride was added to the flocculator and the sludge from the secondary clarifier was returned to the incoming raw sewage after adding lime to the same as indicated. The clarifiers were run in series. The reduction of B.O.D. on weak and medium waste was 3 per cent and 15 per cent better respectively than in Test 1.

In the next test shown on Table 9 ferric chloride was added to the incoming raw sewage which was conducted directly to the primary clarifier without flocculation. Lime was added thereafter at the flocculator before the waste passed to the secondary clarifier. Sludge from the secondary clarifier was returned to the incoming raw sewage. Only medium strong sewage was handled during this test and the results indicated a 3 per cent increase in B.O.D. removal as compared with Test 1. The return of sludge from the secondary clarifier to the incoming raw sewage could only be maintained for a four to five day continuous period inasmuch as septicity developed rapidly after that time.

Test 10 used alum and sodium silicate as coagulants.

This test was conducted over a considerable period of time in cooperation with Mr. L. I. Birdsdall of the General Chemical Company. Apparently the removal of suspended solids was improved on the weak and moderate sewages available during this test, and the B.O.D. removals were materially better. The results of this test must be considered in view of the variable dosages of coagulants used. A distinct improvement in the color and turbidity of the effluent was noted throughout this test.

Table 11 shows typical results of an extended test conducted with the cooperation of Dr. A. J. Fisher of the Dorr Company. This test was started by dividing the rate of sewage flow equally between plain sedimentation and sedimentation following flocculation. The sewage used during the test was a mixture of domestic and packing house waste. The first four days reported upon show equal rates through each clarifier, although the rate of flow was increased from day to day. The positive benefit of flocculation upon the removal of both suspended solids and B.O.D. is apparent. During the last two days reported upon the rate of flow through the plain sedimentation tank was in ratio approximately one to two and one to two and one-half respectively as compared with the rate through the flocculator and its clarifier. Apparently the latter ratio can be maintained with substantially equivalent results.

During this series of tests the time of flocculation and the detention period in the clarifiers were reduced materially at each step and likewise the velocity in the 14-inch interconnecting pipe lines was increased repeatedly. The beneficial effect of flocculation is obvious as compared with plain sedimentation up to and through a rate of flow of 1,150 G.P.M., but the comparative benefit decreased when that rate was exceeded. The velocity in the pipe lines approximates 2.5 feet per second at this rate. The flocculation period approximates 30 minutes and the overflow rate in the clarifier 850 gallons per square foot per day. It should be noted that the results shown in both sections of this particular test were obtained with a single stage or cycle of sedimentation.

In Table 12 the various methods of treatment are compared on the basis of pounds of B.O.D. removed and the cost of chemicals in securing the indicated results.

The pre-treatment plant was deemed necessary at the time of design because of the fear that the strength of

TABLE 6

Lime Added to Flocculator
Flocculated 30 min.—Settled 3 hrs.
Overflow Rate 440 G./sq. ft./day

B.O.D. 400 to 700				B.O.D. 700 to 1000				B.O.D. 1000 to 1500			
pH Raw	Lime gr./gal.	B.O.D. Raw	% Red B.O.D.	pH Raw	Lime gr./gal.	B.O.D. Raw	% Red B.O.D.	pH Raw	Lime gr./gal.	B.O.D. Raw	% Red B.O.D.
7.8	5.6	591	23.2	6.9	5.6	919	34.2	6.8	5.0	1160	33.8
7.0	5.3	552	26.3	6.8	4.9	826	36.2	6.6	5.8	1065	34.1
7.4	5.6	408	27.7	6.7	6.5	796	28.8	6.5	7.1	1130	34.2
7.0	5.1	480	34.2	6.9	6.1	889	30.9	..	..	....	...
6.9	5.6	479	32.4	6.9	6.5	700	18.8	..	..	....	...
7.7	5.8	400	32.2	6.8	5.1	750	35.9	..	..	....	...
7.0	5.2	441	22.7	6.8	5.8	783	44.7	..	..	....	...
7.0	5.2	455	31.5	6.6	6.0	947	32.0	..	..	....	...
..	..	...	...	6.8	3.3	722	19.7	..	..	....	...
..	..	...	...	6.7	5.7	978	12.3	..	..	....	...
..	..	...	...	6.9	3.9	793	35.6	..	..	....	...
..	..	...	...	7.0	5.8	770	11.9	..	..	....	...
..	..	...	...	7.7	6.1	700	43.9	..	..	....	...
Avg.	5.4	476	28.8		5.5	821	29.6		5.7	1118	34.0

TABLE 7

Lime Added to Flocculator
Settled 1⅔ hrs.—Flocculated 35 min.—Settled 1⅔ hrs.
Overflow Rate 733 G./sq. ft./day

B.O.D. 400 to 700				B.O.D. 700 to 1000				B.O.D. 1000 to 1500			
pH Raw	Lime gr./gal.	B.O.D. Raw	% Red B.O.D.	pH Raw	Lime gr./gal.	B.O.D. Raw	% Red B.O.D.	pH Raw	Lime gr./gal.	B.O.D. Raw	% Red B.O.D.
7.1	5.0	444	33.0	6.8	7.3	959	31.1	6.7	5.3	1056	41.1
7.0	5.2	638	39.8	6.9	5.1	778	44.1	..	..	....	...
7.0	2.5	548	15.5	6.9	4.5	715	48.9	..	..	....	...
7.0	3.6	600	38.7	6.8	5.8	755	40.0	..	..	....	...
6.9	4.2	520	19.6	6.7	5.3	860	42.1	..	..	....	...
6.9	3.2	618	28.3	6.7	4.6	914	33.3	..	..	....	...
7.0	5.9	400	12.5	6.7	5.7	895	35.0	..	..	....	...
6.8	5.9	421	35.4	..	..	....	...	..	..	....	...
6.9	5.3	414	35.7	..	..	....	...	..	..	....	...
7.0	5.6	402	26.8	..	..	....	...	..	..	....	...
6.9	4.6	434	47.7	..	..	....	...	..	..	....	...
7.0	5.8	401	32.3	..	..	....	...	..	..	....	...
7.1	5.3	496	41.3	..	..	....	...	..	..	....	...
7.0	5.4	527	35.7	..	..	....	...	..	..	....	...
7.6	4.1	457	34.4	..	..	....	...	..	..	....	...
7.0	5.5	419	29.6	..	..	....	...	..	..	....	...
Avg.	4.8	484	31.6		5.5	840	39.2		5.3	1056	41.1

TABLE 8

$FeCl_3$ Added to Flocculator
Lime Added to Sludge Returned to Raw Sewage from Secondary Clarifier
Settled 1⅔ hrs.—Flocculated 35 min.—Settled 1⅔ hrs.

B.O.D. 400 to 700					B.O.D. 700 to 1000				
pH Raw	$FeCl_3$ gr./gal	Lime gr./gal.	B.O.D. Raw	% Red B.O.D.	pH Raw	$FeCl_3$ gr./gal	Lime gr./gal.	B.O.D. Raw	% Red B.O.D.
6.9	1.0	5.8	625	33.0	6.6	1.0	6.1	968	45.7
7.0	0.7	5.4	572	33.0	6.9	1.1	5.8	762	50.8
Avg.	0.9	5.6	598	33.0	..	1.0	6.0	865	48.2

TABLE 9
$FeCl_3$ Added Raw Sewage, Lime Added to Flocculator
Secondary Sludge Returned to Raw Sewage
Settled 1⅔ hrs.—Flocculated 35 min.—Settled 1⅔ hrs.
Overflow Rate 733 G./sq. ft./day

	B.O.D. 700 to 1000			
pH Raw	$FeCl_3$ gr./gal.	Lime gr./gal.	B.O.D. Raw	% Red B.O.D.
6.8	1.1	5.5	902	35.2
6.9	0.8	3.7	741	37.4
6.6	0.9	3.6	839	29.3
6.8	1.5	3.4	703	33.0
6.9	1.3	3.4	754	46.5
Avg.	1.1	3.9	788	36.3

TABLE 10
Alum and No_2 SiO_3 Added to Flocculator
Flocculated 30 min.—Settled 3 hrs.
Overflow Rate 440 G./sq. ft./ day

	pH Raw	Alum gr./gal.	SiO_2 gr./gal.	Susp. Solids Raw	B.O.D. Raw	% Red Susp. Solids	% Red B.O.D.
a	6.9	6.0	...	580	646	81.9	67.0
b	7.4	5.0	...	294	234	76.9	32.1
c	6.9	3.0	0.54	770	705	88.1	63.8
c	7.1	3.0	0.54	298	255	79.5	43.5
d	7.4	4.0	0.71	250	320	76.3	32.4
d	7.1	4.0	0.71	320	352	74.1	22.4
e	6.9	3.0	1.00	380	380	85.3	60.5
e	7.0	3.0	1.00	530	490	82.8	53.3
f	7.1	4.0	1.40	384	375	82.8	61.1

TABLE 11
Flocculation Plus Sedimentation vs. Sedimentation Alone
Average Results Obtained for Various Rates of Flow

		Settled					Flocculated and Settled					
RAW SEWAGE Susp. Solids	B.O.D.	Rate of Flow G.P.M.	Settling Time, Hrs.	Overflow Rate, G./ft./D.	% Reduction Susp. Solids	% Reduction B.O.D.	Rate of Flow, G.P.M.	Floc-culated Time, Min.	Settling Time, Hrs.	Overflow Rate, G./sq.ft./D.	% Reduction Susp. Solids	% Reduction B.O.D.
226	291	450	3.7	330	46.0	18.5	450	83	3.7	330	69.0	35.4
255	331	675	2.5	494	50.6	19.2	675	55	2.5	494	62.7	23.2
384	368	875	2.0	642	67.5	19.3	875	43	2.0	642	75.5	26.4
411	410	1150	1.5	863	67.0	23.6	1150	32	1.5	863	72.3	29.0
306	384	590	2.9	432	54.3	25.4	1235	30	1.4	907	53.6	25.5
285	294	450	3.7	330	55.55	13.4	1380	27	1.2	1010	59.4	17.7

TABLE 12
Costs of the Various Treatments and Pounds B.O.D. Removed Per MG.

	B.O.D. 400 to 700			B.O.D. 700 to 1000			B.O.D. 1000 to 1500		
Treatment	Cost Per M.G.	Lbs. B.O.D. Removed Per MG.	Cost Per Lb. B.O.D. Removed	Cost Per M.G.	Lbs. B.O.D. Removed Per MG.	Cost Per Lb. B.O.D. Removed	Cost Per M.G.	Lbs. B.O.D. Removed Per MG.	Cost Per Lb. B.O.D. Removed
No chemicals (Table 1)	$0.00	1435	$0.00	0.00	2255	$0.00	$0.00	4390	$0.00
No chemicals (Table 2)	0.00	1755	0.00	0.00	2380	0.00	0.00	4660	0.00
$FeCl_3$ and H_2SO_4 (Table 3)	....	....	....	10.50	2295	0.0046	10.60	5080	0.0021
$FeCl_3$ (Table 4))	7.95	1685	0.0047	6.80	2120	0.0032	7.70	4060	0.0019
$FeCl_3$ (Table 5)	6.80	1620	0.0042	6.25	2600	0.0024	....	....	....
Lime (Table 6)	4.70	1380	0.0034	4.65	2320	0.0020	4.75	3165	0.0015
Lime (Table 7)	4.10	1275	0.0032	4.65	2740	0.0017	4.70	3620	0.0013
$FeCl_3$ and lime (Table 8)	8.10	1650	0.0049	9.05	3480	0.0026	....	....	....
$FeCl_3$ and lime (Table 9)	....	....	....	7.40	2385	0.0031	....	....	....
Alum and $No_2S_iO_3$ (Table 10)a	11.55	3610	0.0032	....	....	....	....	....	....
Alum and $No_2S_iO_3$ (Table 10)b	9.50	595	0.0160	....	....	....	....	....	....
Alum and $No_2S_iO_3$ (Table 10)c	8.45	2240	0.0038	....	....	....	....	....	....
Alum and $No_2S_iO_3$ (Table 10)d	11.20	767	0.0146	....	....	....	....	....	....
Alum and $No_2S_iO_3$ (Table 10)e	10.70	2060	0.0052	....	....	....	....	....	....
Alum and $No_2S_iO_3$ (Table 10)f	14.70	1910	0.0077	....	....	....	....	....	....

the waste originating in the packing plant and the nature of the solids included in the waste would make it impractical to mix with city waste both from the viewpoint of overloading the filters due to relatively inferior clarification, and also because of the odor hazard, should the mixture become septic during primary treatment. From time to time during the operating period of the plant, however, experimental runs sending the mixed raw wastes through the general city plant have been continued for considerable periods. During the month of August, 1937, the plant was continuously operated on this basis. An average of 7.55 million gallons per day of mixed waste, having a B.O.D. of 281 P.P.M., was reduced to 204 P.P.M. through the primary clarifiers, and to 38 P.P.M. in the final effluent. The suspended solids of the raw mixture were 292 P.P.M. during this period, and this amount was reduced to 91 in the effluent of the primary clarifiers and to 28 in the final effluent. No odor difficulties whatever were encountered. The B.O.D., however, of the incoming wastes was reduced by the introduction of approximately one million gallons per day of clear condenser water from the packing plant during the experimental run.

In Summary

While no attempt has been made to draw final conclusions from, or to generalize upon the results thus far obtained, the following observations are probably safe:

(1) Fine screening of strong packing house waste has produced highly beneficial results in preparing the sewage for further treatment. The concentration of the sewage delivered to the plant for treatment is consid-

erably below preliminary forecasts based on analyses of unscreened waste.

(2) Thirty minute flocculation is beneficial as preparatory to sedimentation. It makes materially greater removals of suspended solids and B.O.D. possible as compared with similar detention periods and overflow rates where plain sedimentation alone is used. The foregoing statement holds true when clarifier depths are approximately 5 feet, where the detention period is not less than 80 minutes, where the overflow rate does not exceed 850 gallons per square foot per day, and where the velocity of flocculated liquid in pipe lines or channels does not exceed 2.5 feet per second. When these limits are exceeded, benefits apparently are reduced. Maximum benefits occur at low rates of flow.

(3) The use of coagulants is unwarranted and unnecessary in this particular case until loadings become much heavier than at present.

(4) Further studies should be conducted using heavier chemical dosages than reported upon here. The increased operating cost thus involved and computed on the basis of pounds of B.O.D. removed should, however, be balanced against the expense of enlarging clarifier capacities when heavier loadings develop.

(5) Packing house wastes can be mixed raw with domestic sewage and treated by ordinary means with good results and with no odor difficulties and no septicity under ordinary clarifier detention periods. This statement holds true up to a volumetric ratio of at least one to four and a pounds of B.O.D. ratio of one to five. The foregoing ratios are on a 24-hour basis and may be exceeded materially for periods of several hours each day without objectionable results.

(6) So far as the successful operation of standard trickling filters is concerned, it is adequate to remove suspended solids of mixed packing house and domestic sewage down to a maximum of 150 P.P.M. This statement holds true when monthly average filter dosages are reduced as low as 1.5 million gallons per acre per day.

▼

New Joint Sanitary Engineering Laboratory Goes into Service at N. Y. U.

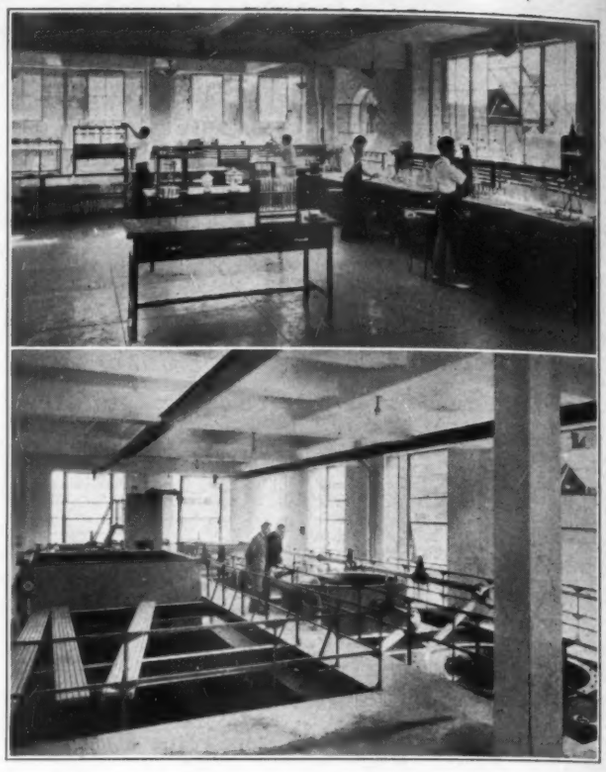
Mayor LaGuardia—"No 'Boondoggling' in this WPA Project"

On September 13th, New York's big-little Mayor stepped up to a microphone in the new and shining Sanitary Engineering Laboratory just completed on the campus of New York University. And, in his dedication speech, told the world that New York City was going through a "New Deal" in respect to general sanitation and the disposal of its sewage and garbage.

As one bit of evidence, he stood in a completely new building (financed through WPA assistance, built by the City of New York and turned over to New York University) to serve in the joint research and study of sewage disposal methods and practices by the City and New York University's Department of Sanitary Engineering.

Thorndike Saville, Dean of Engineering at N. Y. U., in accepting the completely equipped laboratory and experimental station, designed and equipped under the guidance of Lewis V. Carpenter, Professor of Sanitary Engineering, emphasized the uniqueness of this cooperative enterprise between a municipality and an educational institution, which is apparently the only instance of its kind on record.

As the accompanying picture reveals, the upper floor is devoted to a general laboratory and individual research laboratories. On the lower two floors is the experimental



The New Sanitary Engineering Laboratory and Experimental Station at N. Y. University.

station equipment, capable of handling sewage flows up to 100,000 G.P.D. and subject to process or equipment testing and study or development, with split sewage flows passing through the station in parallel.

Mayor LaGuardia pointed with some pride to the progress being made in a 12-year program of sewage disposal betterments in New York City at an estimated cost of $300,000,000, as distinct from the past 50 years of "Political Sewage Disposal" as had been practiced by America's largest city. As a part of the program, he said, the new laboratory had been built and was now to be turned over to the University to be entirely under the direction and control of the staff of the University, and thus removed from political interference. In return, five young engineers from the Department of Sanitation of the City were to be given scholarships each year by the University. The courses would be pursued by these young men while being continued on the pay rolls of the City. This, in order that they might come back better equipped and more valuable to the Department of Sanitation.

The new laboratory and experimental station has been placed under the direct supervision of Professor Carpenter and his staff, while Dean Saville watches the progress of the enterprise that he, Mayor La Guardia and WPA have good reason to take pride in.

▼

William Raisch Consulting Engineer

So reads the heading on a card just received which announces the opening of a consulting sanitary engineering office by Mr. Wm. Raisch at 227 Fulton St., New York City.

Mr. Raisch—better known as "Bill" Raisch—has for many years been connected with developmental and sales work in the sanitary engineering field. Until recently he has been connected with the Municipal Sanitary Service Corporation of New York City. His many friends will wish him well in his new undertaking.

THE "TANK FILTER"

For the Purification of Sewage and Trade Wastes

Part I.

By DR. H. BACH*

Consulting Chemist, Berlin

The Author

SINCE the recent valuable work of H. O. Halvorson and of H. N. Jenks has created anew a lively interest in the trickling filter, which sewage treatment device has been in recent times somewhat overshadowed by the activated sludge method on the one hand, and by the "chemical-mechanical" movement on the other, it may now perhaps be the proper time to direct the attention of American sewage disposal engineers to another form of biological filter, already employed in Germany and other European continental countries; but, as far as I am aware, as yet tested in America only in a few cases, chiefly on an experimental scale. I refer to submerged contact filters, provided with artificial aeration. Such filters (in Germany), are mostly known as the "Emscherfilter," the broader term being "Tauchkörper." In the English-American literature, particularly in patent specifications one may find such terms as "submerged contact aerators," "immersed aero-filters" and the like. In order to avoid an awkward nomenclature I would like to suggest for this form of biological oxydizing filter the term "Tank Filter." The tank filter differs from the trickling filter in just the way that a man taking a bath differs from a man exposed to rain.

Former Filters and Tank Filter:

In sewage disposal technique there are in use on a large scale two different types of biological filters: the older contact beds, and the later developed trickling filters. In introducing the still newer type of biological filter—namely, the "Tank Filter"—it may be useful in order to understand the action of the latter to compare, both the predecessors of the new device as to their respective advantages and disadvantages in construction and operation. (See Table I.)

Early Experiments:

In the early post-war period, while experimenting with activated sludge in small scale units and realizing that only a small fraction of the air blown into the liquid served to the real purpose of feeding oxygen to the bacteria, the rest of the air escaping unutilized, I was searching for some means of securing a substantially higher air utilization. As it is well known, the solution of this difficult problem has been tried by other technicians in different ways. It was originally my idea to let the air bubbles strike against rough surfaces in order to delay the rising of these bubbles by creating an adhesion to the said surfaces and, thereby, prolong their contact with the liquid, consequently bringing about a somewhat higher solution of the oxygen in the water. This view led me to fill the aeration chamber with coarse slag. I could very soon confirm my first conception, that in this way the results from a small quan-

TABLE I

"Contact Beds" and "Trickling Filters" Compared

Items	Contact Bed	Trickling Filter
Head needed.	Very small, substantially a few inches, because only comparatively shallow tanks and no head consuming distribution devices come in question.	Substantial, some six feet or more, because the contact material is heaped upon the floor and the distributing devices usually require an additional head.
Area required.	By far larger than in the case of trickling filters, because of the flat shape of the contact beds and of their comparatively smaller loading possibilities.	Comparatively much smaller, because of the construction height and the greater load.
Temperature conditions with regard to the cold season.	Favorable, as the liquid becomes only slowly cooled.	Unfavorable, as the liquid cools quickly, which may lead to freezing of the liquid and an interruption of the working.
Distribution of the liquid.	No complicated devices of any sort are needed. The feeding and the emptying of a contact bed may be accomplished by very simple means.	The even distribution of the liquid onto the surface of trickling filters is somewhat difficult, and requires some more or less elaborated, properly working apparatus.
Contact time.	May be regulated at will.	Cannot be controlled, because it depends unchangeably on the head, on the size of the material, and on the working of the distributor.
Action of the air with regard to the biological growths.	Is restricted to the emptying intervals. The satisfaction of the real oxygen demand of the bacteria is difficult unless undue time for aeration of the emptied bed is practiced.	Provided effective ventilation, unrestricted, because the air has continuous access.
Capacity.	Lessening comparatively quickly, because of the accumulation of the sludge in the voids of the contact material.	Substantially non-lessening, as the sludge or humus particles are rinsed away with the effluent.
Odor nuisance.	Slight, if at all, as the contact surface between the liquid and the air is comparatively small.	Bad odor nuisance may arise if the sewage is foul, because in the course of distribution and flow down the filter, the liquid comes in very intimate contact with the air.
Fly nuisance.	The alternate filling and emptying of contact beds offers no opportunity for flies to settle down and to multiply.	The fly nuisance of the trickling filter is a well known fact.
Washing of the contact material and the working reserve.	The accumulation of the sludge requires in some intervals the thorough washing of the contact material in order to remove the sludge and to restore the capacity of the bed. An appropriate working reserve is therefore indispensable.	No special washing of the material and therefore no working reserve required.
Surface ponding.	Is out of question because of the fill and draw working.	May occur, as the consequence of abundant surface growths.
Quality of the effluent.	Usually somewhat inferior to the effluents of the trickling filters. To afford high-class effluents, usually one has recourse to two-stage contact beds, the first one filled with a coarser, the second with a finer grain.	In the most cases very satisfactory, especially with a high content of dissolved oxygen, although usually somewhat inferior to activated sludge plant effluents.

*Formerly Chief Chemist, Emschergenossenschaft, Essen.

Note.—The length of Dr. Bach's paper, with the several illustrations, makes it necessary to print it in two parts. The second installment will appear in our next issue.—Ed.

tity of air were, by far, better than by its unhindered passage through water. I realized, in addition, that the flocs of sludge separating and passing through to the settling compartment differed in their condition from the flocs of activated sludge, being quite similar to the so-called "humus" as produced by trickling filters. Further observation led me to the conviction that a new type of a biological filter had been originated, having the form of a contact bed, but with an action corresponding to a trickling filter, the aeration taking place continuously.

Advantages of the Tank Filter:

Referring now to the items listed in the above table, it may not be difficult to detect, that this new type of filter exhibits the advantages of the contact bed and the trickling filter, while the disadvantages of both appear to be eliminated. Furthermore, referring to the activated sludge treatment, there proves to be with the tank filter the enormous advantage that the sludge produced is of the nature of "humus" and not of activated flocs, when considering physical condition and volume. This status does more than counterbalance the obvious fact that the liquid capacity of a tank filter may amount only to about one-third the capacity of an activated sludge aeration chamber. This, because about two-thirds of the tank filter space is occupied by the contact material. There is also to be considered that the detention period (the aeration time) in a tank filter is generally considerably shorter than in an activated sludge aeration chamber, which circumstance more or less compensates for the higher capacity of the latter. In common with the activated sludge treatment the tank filter affords the possibility of time control, enabling the detention period to be regulated in accordance with the contact and aeration time required for the biological purification of the liquid to be treated.

Very much in favor of the tank filter, when compared with activated sludge treatment, is the noteworthy ability of the former to handle some industrial wastes which may destroy the delicate flocs of activated sludge. This feature enables the tank filter to deal with several wastes, the treatment of which is out of the question by the activated sludge method. No bulking occurs in a tank filter and, if a strong wave of poisonous industrial waste happens to damage the biological slimes coating the contact material, the ripening anew of the material requires a far shorter time than to build up anew the activated sludge flocs, in a sufficient amount, if destroyed in a similar way.

Further, I may mention two important points in which tank filters are distinguished from trickling filters. In tank filters the entire cross-section of the filter body is utilized, while in operation of trickling filters a strata action occurs, the upper part of the filter being more engaged in the biological action than the lower strata. It may even occur that, above the bottom, several feet of the trickling filter are not utilized at all, there being almost impossible to determine in advance the true depth of the trickling filter body necessary for the degree of purification intended. The second point is that the construction of the tank filter makes it possible to alternately reverse the direction of the flow in this filter, thus enabling an equalization of load and accordingly of the biological action throughout the entire filter body. Such is naturally not permissible in trickling filters wherein the flow is possible in one direction only.

Causes of Neglect:

With such favorable attributes, the tank filter might have been more generally employed in broad sewage disposal practice than was the case, had not the development of this device taken place contemporaneously with the ascendency of activated sludge treatment with its novel appeal to sewage disposal engineers. Moreover, post-war difficulties (in Germany) were for years very unfavorable to initiative in the field of sewage disposal. These and other circumstances, not to be mentioned here in detail, prevented the large scale application of tank filters to the extent appropriate, when weighing the practical advantages offered by this device. Nevertheless, it is possible to point to several examples of successful application of tank filters, some of which will later be described.

In the Treatment of Industrial Wastes:

The chief use of tank filters, in Germany, has been found in the purification of certain industrial wastes. Among these, the first successful use was the treatment of wastes from coke oven by-product plants, gas works and other wastes containing phenolic compounds. It may seem at first glance somewhat paradoxical that such wastes, known to have a high disinfecting power, should be treated biologically. Credit must be given to Dr. G. W. Fowler, who demonstrated that gas works effluents, if sufficiently diluted, may be satisfactorily purified on trickling filters. However, Fowler's method, as originally applied, suffers from the very large filter bed area required for treating the waste liquors after the requisite 20 to 1 dilution. Such large areas usually are not to be had at industrial plants. Tank filters, on the contrary, appear to be fairly well suited for such cases. This, because they are able to handle a far more concentrated liquid than trickling filters and accordingly require a substantially smaller area; also, because of other advantageous conditions inherent to this process as compared with trickling filters.

Examples of Going Plants

The Helene Plant

The first installation of this kind was the plant built by the Emschergenossenschaft at the coke oven by-product plant attached to the Helene coal mines near Essen. In this, as in other coke oven by-product plants, the scrubbed gas liquor after addition of milk of lime is heated in stills in order to expel the ammonia gas, which usually is absorbed in sulfuric acid, thus forming sulphate of ammonia, or in water, forming concentrated ammonia liquor. The hot ammonia-free spent lime liquor from the stills passes clarification tanks, in which the lime sludge settles, leaving a highly alkaline clear brownish liquor with a strong phenolic smell. The composition of such liquors varies within wide limits—the factors involved being the sort of coal coked, coke oven and the scrubber apparatus construction, working conditions in the ammonia distillery, etc. In the following table are indicated the upper limits of the contents of by-product wastes from the Ruhr district collieries.

The constituents which cause the chief difficulty in the treatment of such wastes are the phenols. Their durability and high toxicity to bacteria, justify the term "phenolic wastes." The phenols as a rule are not present in free state but mostly as calciumphenolates dissolved in the water. As these compounds become slowly hydrolyzed in the presence of carbon dioxide from the air, the liquor smells more or less "hospital-like."

TABLE II

Chief constituents in wastes from coke oven by-products plants (settled ammonia still liquors) in the Ruhr coal mine district (Emschergenossenschaft).

	Upper limits in p.p.m.
Suspended solids (1)	200
Solids in solution (2)	9,000
Total lime (computed as CaO)	1,900
Alkalinity (computed as CaO) (3)	1,060
Chlorides as Cl_2 (chiefly $CaCl_2$)	2,800
Total Nitrogen (without CN-Nitrogen) (4)	550
Ammonia-Nitrogen	450
Organic Nitrogen	250
Total Sulphur (5)	1,400
Sulfocyanates (as CNS)	260
Phenols (computed as C_6H_5OH) (6)	5,500
$KMnO_4$-consumption (Kubel-Tiemann test)	40,000
Resp. Oxygen Consumed	10,000
B.O.D. more than (7)	10,000

(1) The liquors carry sometimes more or less tarry substances escaped from the sedimentation tanks.

(2) Partly owing to varying composition of commercial lime used for the preparation of milk of lime.

(3) A small fraction of total alkalinity usually is caused by residual ammonia.

(4) Nitrates or Nitrites were not found.

(5) In sulphates, sulphides, sulphuretted hydrogen, sulfocyanates, and in organic compounds.

(6) The "Phenols" are an irregular mixture of tar acids, chiefly carbolic and cresolic acid, in varying proportions. In wastes originating from brown coal (lignite) carbonization, higher homologues of phenol in appreciable quantities may also be present. In such wastes the total phenol content may sometimes reach as much as 10,000 p.p.m.

(7) The determination of B.O.D. in such wastes is very difficult and undependable. The very high dilution required forms a source of error multiplied by the degree of dilution.

The tank filter ("Emscher filter") plant at the Helene coal mine treated some 700 cu. ft. of the settled wastes daily (24 hours). The wastes were mixed with about 1/10 of their volume of sewage from workers' latrines, previously clarified in an Imhoff tank. This, with the view of providing the oxidizing bacteria with some supplementary nourishing substance and avoid a "food monotony." The liquor was then further diluted with effluent from the waste treatment plan in proportions of 1:4 to 1:5 according to the very concentration of the waste. Thus ¾ to ⅘ of the liquor was recirculated through the tank-filter, while ⅕ to ¼ left the plant as purified effluent. This procedure was necessary as no other diluent in sufficient quantity was available. Fig. 1 illustrates the procedure schematically.

The dilution with the effluent in the winter time lowered the temperature of the hot wastes to about 24 to 27 degrees centigrade, just well suited for biological treatment, but in the summer time it was sometimes necessary to cool the incoming waste liquors, using a simple wooden tray cooling device.

The filter tank contained 2,200 cu. ft. of slag of 1.5 to 2.5 in. size, thus leaving a total voids space of about 850 cu. ft. In the course of bed "ripening" the voids were lessened to about 750 cu. ft., owing to the depositions of the biological slimes. After the contact material was ripened, this taking some two weeks time, the 3,500 to 4,200 cu. ft. daily of the diluted wastes

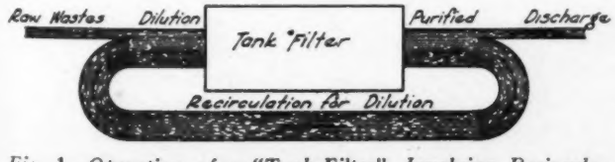


Fig. 1—Operation of a "Tank-Filter", Involving Recirculation of the Effluent, Schematically Illustrated

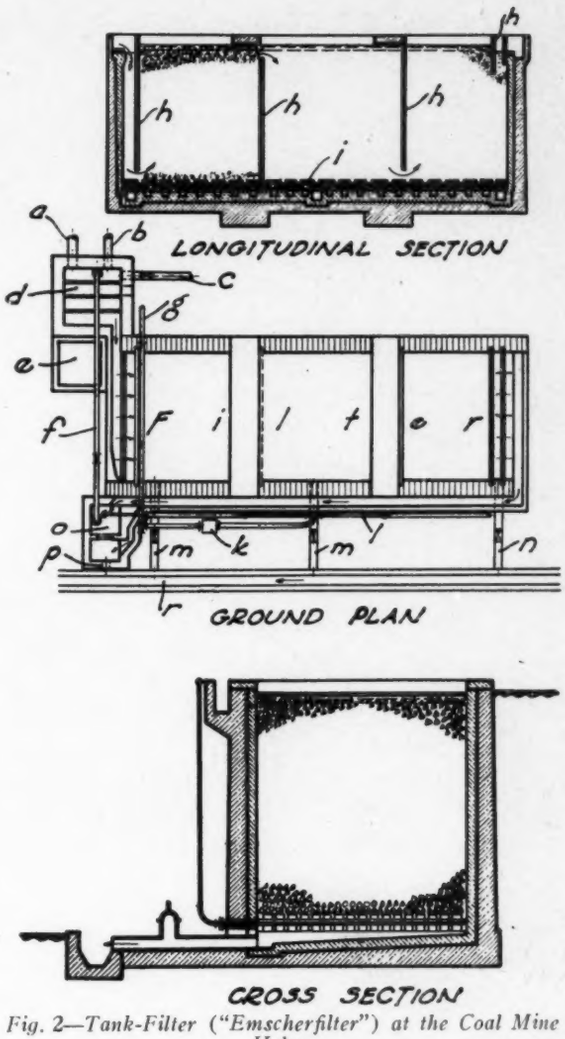


Fig. 2—Tank-Filter ("Emscherfilter") at the Coal Mine Helene

a—inflow phenol wastes; b—inflow sewage; c—inflow cooled phenol wastes (in the summer time); d—mixing chamber; e—foam collecting chamber; f—recirculation pipe; g—recording thermometer; h—baffles; i—aeration grill; k—air meter; l—compressed air piping; m—drain; n—effluent; o—pumping sump (mammoth recirculating pump); p—pumping sump overflow; r—discharge ditch

passed the filter in about 4¾ to 5½ hours, depending upon the dilution ratio.

In Fig. 2 the chief parts of the tank filter are indicated, while Fig. 3 is a view of the plant.

While passing the filter, air was blown upward in the liquor from a system of perforated pipes laid on the bottom of the tank and connected to a colliery compressor. The aeration pipes were introduced in the tank from the outside, as shown in Figs. 2 and 3, crosswise to the flow direction of the liquor. The baffles shown in Fig. 2 prevent a short circuiting in the filter. After the contact material was ripened there was a heavy foam production on the surface of the filter, owing to the large amount of carbonic acid resulting from the biological oxidation (wet combustion) of the organic substances of the wastes. The foam forming in the tank filter process indicates an effective biological purification; when the latter lessens the foam production usually lessens also.

The detention period in the tank filter is easily adjusted by raising or lowering the overflow weir on the effluent side of the tank.

Fig. 3—View of the Tank-Filter ("Emscherfilter") for Phenol Wastes Purification at the Colliery Helene near Essen. The Inflow at the Rear, the Effluent (Adjustable Baffle) at the Front, the Air Distributing Pipe System at the Left Side. (See Sketch for Details)

The effluent was collected in a sump from which an air lift (Mammoth pump), served by a branch of the compressed air pipe mentioned above, raises the required amount (for dilution) to the inflow chamber. The rest of the effluent, carrying suspended solids rinsed from the filter, overflow to a small brook discharging into an Emscher river tributary. The foam from the surface of the filter was diverted back to the inflow by means of a simple rake.

The suspended solids rinsed from the filter in general resemble the "humus" of trickling filters, although containing some small particles of resinated substance formed by direct oxidizing action on the phenols, apart from the biological oxidation. The constant blowing of the air into the filter caused an even discharge of the suspended solids and their outflow with the effluent. However, in case of a clogging of the filter, due to sludge accumulation between the contact material, quick dump-valves in the side of the bottom of the tank below the air pipe grill were provided. By opening these valves the tank could be emptied in about a quarter of an hour, the downrush of the water dragging the sludge out of the filter. This device was in fact used only seldom and it proved sufficient in such cases to empty only the upper part of the filter, because the sludge becomes loosened and is flushed out along with the first downrush of the water.

After approximately a year's operation the Helene plant was rebuilt. It was divided into three independent filters, fitted with different sizes and sorts of contact materials (boiler slag, blast-furnace slag, and lava rock), differing also in certain technical equipment which should have been tested with regard to its later use in a large scale size. Owing to the dividing walls between the three compartments and to other appliances, the total volume of the three new filters was smaller as compared to the previously undivided filter.

After the rebuilt plant had been working about half a year, the three filters were tested on the basis of inflow-outflow when corresponding samples were collected at 15-minute intervals for 48 hours. Because of the limited means of the testing laboratory each filter was tested independently, one being tested after another was finished, with some time elapsing between two tests. The aim of these tests tabulated below was chiefly to collect data concerning destruction of phenols in the filters. The results may be regarded as representative for the treatment of phenolic wastes of such sort.

As later experience in this and other plants confirmed (in general) the data of the above table, it may be taken as a rough average, but subject to some fluctuations with the local conditions, especially with the content of the wastes in other constituents besides the phenols.

It can be stated now, based on experiences, that the purification of phenolic wastes by means of tank filters requires:

1. Dilution to a degree that the content of phenols in the diluted liquor should not exceed some 250 p.p.m.
2. Effective tank volume, for the filter body, should be about 15 cu. ft. per pound of phenols to be handled each 24 hours.
3. The volume of air, under pressure sufficient to penetrate the water pressure in the filter, should be about 2,500 cu. ft. sucked in air per pound of phenols per 24 hours. Usually ¼ to ½ atm. over pressure will suffice.
4. Required detention (aeration and contact time)

accordingly to the flow and concentration, but not less than one hour.

5. Addition of some bacteria feeding liquid (e.g. sewage) in small proportion.

Phenol Recovery:

With these basic requirements, adjusted to local conditions, the tank filter treatment represents the most reliable as well as an area and power saving, and economically advantageous procedure for the disposal of phenolic wastes as far as phenol destruction is aimed at. In case the content of the more valuable phenols, such as carbolic acid and the cresols (the higher homologues being scarcely marketable), proves to be high enough first consideration should be given to the economy of installation and working of an adequate extraction plant, including the cost of the extraction solvent (e.g. benzol), the required steam, etc. In so-called gas water (scrubber liquor, raw ammonia water), 2,500 p.p.m. phenol content usually representing the lowest limit permitting operation of recovery plants without some financial loss. In the case of ammonia recovery wastes the extraction process is not applicable at all. The calcium phenolates do not dissolve in benzol and like solvents and an acidification of the wastes, with the view to set free the phenols and make the extraction possible, would include numerous difficulties prohibiting such treatment.

Final Treatment:

As indicated in Table 3, some few p.p.m. phenols still remain in the tank-filter effluent. In case the last traces of phenols must be removed the filted plant should be enlarged. In such cases it may prove expedient to arrange the tank filters in two stages with decreasing size of contact material, removing in the first stage the phenols to about 30 p.p.m. and completing the phenol destruction in the second stage. Often, however, a simpler method of after-treatment, such as the intermittent sand filter or subsoil irrigation and the like provides, may be employed if local conditions are suitable.

Pretreatment:

It is recognized that the action of the tank filter may be facilitated by a suitable pretreatment of the wastes; especially the careful removal of tar and oil frequently remaining in sedimentation tank effluents, and the sulphuretted hydrogen arising by hydrolysis of

TABLE III

Phenol Destruction in Tank Filters—Helene Plant

Items		Proportions	Tank-Filter (Emscherfilter) No. 1	No. 2	No. 3
Filter total volume		cu. ft.	540	526	551
Voids space after ripening		cu. ft.	159	244	177
Per cent of the total volume in void space		per cent	29.4	46.4	32.1
Detention period		hours	3½	5½	4½
Phenolic wastes treated		gal./24 hrs.	1,915	1,394	1,465
Dilution with sewage and filter effluent		ratio	1:4	1:5.5	1:4.5
Compressed air (about ¼ atm.) applied		cu. ft./1 hr.	1,589	706	706
		cu. ft./24 hr.	38,136	16,944	16,944
Phenol Content	Undiluted wastes	p.p.m.	1,070	1,235	1,045
	Diluted wastes (inflow)	p.p.m.	214	190	190
	Filter effluent	p.p.m.	8	7	7
Phenol reduction with regard to the diluted liquor		p.p.m.	206	183	183
		per cent	96.3	96.3	96.3
Phenol reduction with regard to the undiluted wastes		p.p.m.	1.062	1.228	1,038
		per cent	99.3	99.4	99.3
Load per cu. ft. per 24 hrs.	Undiluted wastes	gallons	3.5	2.7	2.7
	Diluted wastes	gallons	17.5	17.55	14.85
	Phenols	grams	14.18	12.65	10.68
		pounds	0.031	0.028	0.024
Consumption of compressed air	Per cu. ft. of undiluted wastes	cu. ft.	152.4	92.4	88
	Per 1.000 gallons undiluted wastes.	cu. ft.	20,380	12,350	11,760
	Per pound phenol removed	cu. ft.	2,380	1,240	1,400
Phenols removed from 1.000 gals.	Undiluted wastes	pounds	8.58	9.93	8.38
	Diluted wastes	pounds	1.72	1.53	1.52

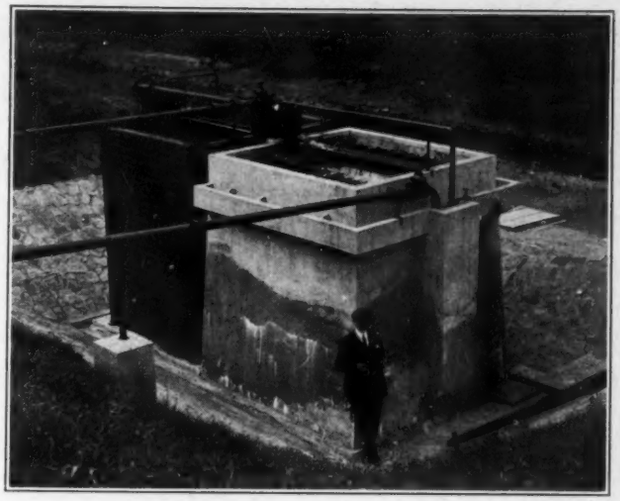


Fig. 4—Phenol Wastes Purification Plant at the Colliery Nordstern Near Essen. On the Right the Tank-Filter ("Emscherfilter"), on the Left a Wooden Lath Trickling Filter Built for Comparison. On the Top of Both Filters May Be Seen the Distribution of the Wastes by Means of Tipping Troughs

calcium sulfide. The detarring of the liquor and the removal of hydrogen sulfide may be effected simultaneously by means of preaeration which removes the tars and oils in the shape of foam while the hydrogen sulfide is blown out with the air.

The Nordstern Plant

A second, and far larger plant, for similar wastes of another colliery was built by the Emschergenossenschaft for the coke oven by-product plant at the Nordstern coal mine in the northern Ruhr coal district. Here difficulties arose in securing sewage to be mixed with the wastes, and recourse was had to cow dung made up to a thin liquid, small portions of which were applied to the slag during the two weeks of beginning operation, in order to hasten the ripening of the filter. Afterwards this additional bacteria food was applied at intervals of six weeks and in small amounts only.

Fig. 4 shows the Nordstern plant. Parallel with the tank filter (Emscherfilter), which occupies a tower-like position resulting from the sloping terrain, may be seen a wooden lath trickling filter built for the purpose of comparison of the action of both the devices. Just as it was expected, the phenol removal through the tank filter was by far more effective, the effluent as a whole far better and more uniformly purified. As a pretreatment device for this plant was used a coarse coke contact filter inserted between the lime sludge sedimentation tank and the plant inflow. It proved effective as a tar and oil restrainer, but required far more area than a preaerator.

(*To be concluded in our next issue*)

Georgia Water and Sewage School November 3-6th

The Sixth Annual Georgia Water and Sewage Plant Operators School will be held in Atlanta, November 3, 4, 5 and 6, 1937. This school is conducted by the Sanitary Engineering Division of the Georgia State Department of Public Health in cooperation with the Georgia Water and Sewage Plant Operators Association and the Georgia School of Technology. The sessions will be divided into water purification discussions, laboratory work, plant inspections and demonstrations of water distribution and sewer system construction and maintenance practices.

OPERATOR VS. ENGINEER

A Round by Round Report from the Ringside Otherwise a Report of the Tenth Annual Convention of the California Sewage Works Association

By A. M. RAWN*
Associate Editor.

CLOSE by the Franciscan Mission Santa Clara, founded in 1777, early California Spanish settlers established the Pueblo de San Jose de Guadalupe. The commanding location of the pueblo at the south end of San Francisco Bay and the amazing fertility of the alluvial soil in the area were the justification for selection of the site for colonization at that early time. The passing of years has attested the wisdom and foresight of those long-gone pioneers. The little, sleepy pueblo has grown to a city of seventy-five thousand population and, together with its immediate environs, is today classed as a metropolitan area by the rules which define such localities.

Rich in its heritage and progressive in spirit, there still lingers something of the old pueblo atmosphere in San Jose and many of the ancient landmarks and buildings have been preserved and are reverenced as they stand today "cheek by jowl" with the modern.

(1) *Ed. A. Reinke (Berkeley) Retiring President, and John Carollo, Consulting Engr., Phoenix, Ariz.;* (2) *Fred D. Bowlus and Geo. A. Parkes, Los Angeles;* (3) *G. Kjellberg, Supt. Sewers, Riverside and Granddaughter (He Hasn't Missed Any of the Meetings);* (4) *W. T. Knowlton (Los Angeles) and R. Ribal (Berkeley) Sec'y-Treas. of the Association.*

The first capital of the State, San Jose failed to make that honor permanent and the wandering legislature moved to Vallejo, thence to Benecia, finally settling in Sacramento, where, to the great despair of folks residing south of the Tehachapies, it appears to be fixed.

Here in San Jose, joining forces with the League of California Municipalities, the California Sewage Works Association met in tenth annual convention on September 13 and 14, 1937. City Manager C. M. Goodman extended the city's welcome, promising immunity to members and guests who became overstimulated with the famous fruit of the grape, grown so extensively and processed so exceedingly well in the neighborhood. San Jose's cordial hospitality, aided and abetted by its perfect Indian Summer weather, added greatly to the enjoyment of the meeting.

On Monday morning, September 13, the Association caravaned to an inspection of one of the largest of western fruit and vegetable canneries—that of Pratt-Low in Santa Clara, where packs of peaches, apricots, pears and tomatoes were being processed; thence to the Santa Clara sewage treatment plant to see what became of the cannery waste, following which respects were paid to the Imhoff trickling filter plant of Los Gatos, the oldest in the State.

At a noon luncheon held at the Hotel de Anza in San Jose, (de Anza, by the way, being the emissary from Mexico who colonized the peninsula area in the latter Eighteenth Century), a word of welcome from San Jose's city manager was followed by a brief address from H. A. Mason, founder and first president of the League of California Municipalities. Mr. Mason discussed the history of San Jose as well as of the League and described the first sewage treatment plant in California—a septic tank which resulted from an accidental washout below a temporary sewage retention tank. The washout was not repaired; instead baffles were constructed in the resulting hole in the ground and patents applied for on a new type of septic tank! Not entirely familiar with many of the recent advancements in the sanitary sciences, Mr. Mason nevertheless drew sharp contrasts between the old and the new throughout the State.

Following luncheon the afternoon session opened with a discussion of sewage treatment plants visited, and a two-fisted symposium in which plant operators and engineers discussed one another's shortcomings and aired their views. Much that was humorous was really pointed and barbed and the participants really "took down their back hair" and "opened up" on one another's shortcomings. The evening annual dinner at Lo Curta's Tavern honored Hollis R. Thompson, City Manager of Berkeley, who pieced together the functions of municipal government, finally presenting a pattern which showed the ramifications of legislative, executive and judicial duties and directed those engaged in sewerage practice to their proper place in the picture. Mr. Thompson, an ardent advocate of sanitation, closed his remarks with a plea for a better understanding of government by all citizens.

Business Session

Sessions reconvened at nine o'clock on Tuesday morning with a business meeting at which R. F. Goudey reported that fifty certificates had been issued to California sewage plant operators, classifying them in Grades I, II or III. Mr. Goudey, 1937 Operators' School Chairman,

*Assistant Chief Engineer, Los Angeles County Sanitary Districts.

also reported on the successful school for plant operators held at University of Southern California, Los Angeles, in the Spring. W. A. Allen, Chairman of the Committee on Annual Award, reported new regulations to be followed in the annual award of merit for the best operated plant in the State. The cash award of $25.00 to the successful operator, in addition to the plaque, was re-established; and it was decided to award certificates of merit to the second and third best plants chosen each year in the contest. The latter certificates are to be accompanied by $15.00 cash award to the second best plant operator, and $10.00 to the third. Rules governing the contest are greatly simplified in order to admit of freer competition. The business meeting was concluded with election of officers for 1938. R. F. Goudey was elected president; Alexander Bell, first vice-president; H. G. Smith, second vice-president, and R. R. Ribal, re-elected secretary-treasurer. The business meeting concluded, five technical papers were presented prior to adjournment at five o'clock p. m.

"The Santa Clara Sewage Treatment Plant," by ALBERT CASTRO, Plant Operator.

The Santa Clara plant serves the city's population of 7,000 and in addition, two canneries, three packing houses, a walnut packing factory, a tannery and two small creameries. The average daily flow varies from 1,100,000 gallons during the fruit canning season, to 560,000 when the canneries are not operating. Plant effluent is used for broad irrigation on the 250-acre farm surrounding the plant. Mr. Castor called attention to the fact that some land upon which a rather poor quality of sugar beet was grown prior to irrigation with sewage effluent, was greatly improved in fertility after such practice started. Santa Clara treatment comprises plain subsidence and two-stage digestion, the process shows an average reduction in suspended solids and B.O.D. 57 percent and 27 per cent, respectively, during the canning season, and 70 per cent and 42 per cent when the canneries are closed. Under present conditions sludge digestion results in a reduction of 45 per cent in the volatile solids content with an average gas production a little in excess of 7,700 cubic feet, or 1.1 cubic feet per capita, per day. Sixteen and three-tenths cubic feet of 47 per cent methane gas per pound of digested volatile solids is noted in the analyses. The analysis is questioned, however, because of a showing of 14 per cent nitrogen and 6.21 per cent H_2S. Mr. Castro appeared to believe that by scrubbing, the sulphide gas could be removed and put to use as an insecticide in spraying fruit trees.

Unique among Santa Clara's industrial wastes is that which results from packing English walnuts for shipment. The nuts are washed in a chlorine solution which is subsequently discharged to the sewer. At times during the 25 days of walnut plant operations in October, residual chlorine in the incoming sewage reaches 12 parts per million and bacterial action stops entirely in the sludge digestion tanks.

"Symposium by Operators, Engineers and Equipment-men on Operating Problems."

As in the Spring meeting in Stockton, the operators present thoroughly condemned the practice of designing and constructing sewage treatment plants without benefit of the practical knowledge of operators. At the San Jose meeting FRED WEST of Stockton, leading the discussion for the operators, reiterated this complaint and roundly cursed the man responsible for bar screen openings three inches wide, followed immediately by the small diameter sewage pumps. He stated that, almost without exception, the operator had to help out quite extensively on every operation involved in the treatment process. He likewise issued a word of warning against sludge thickening tanks, stating that without adequate protection they were especially effective in the breeding of flies. He voiced the opinion of all of the operators, as well as that of a number of the engineers present, when he stated that "whenever new equipment appeared on the market and was included in a treatment plant, the manufacturer should be required to guarantee its operation for a period of one year and remove it at his expense and refund the original price to the plant owner, in case of failure."

(1) *L. J. Sheridan (Anaheim), J. P. Smith (Santa Ana), G. L. Walter (Fullerton)*; (2) *B. D. Phelps (San Diego), a Director*; (3) *Luncheon in the Patio (from left): Jewell, Travaini, Bowen, Johnson, Frick*; (4) *The President—R. F. Goudey (Los Angeles), Prof. Chas. Gilman Hyde, C. G. Gillespie, Chief Engr., State Dept. of Health.*

J. H. VAN NORMAN, Los Angeles, criticized the practice of imbedding electrical conduits in concrete structures. He said he felt that they should all be placed above the floor and outside the concrete so that they might be removed and dried out or replaced as occasion required. He also directed attention to the fact that at the Hyperion Screening Station of Los Angeles the influent channels to the screens were now equipped to draw sewage from the top instead of the bottom, thus preventing the accumulation of float at the farthest screen downstream.

J. A. CLARK of Medford, Oregon, described a new activated sludge plant recently placed in operation at that point; emphasized the necessity for the proper lubrication of machinery. He spoke feelingly of an air blower of 1,500 cubic feet per minute capacity, equipped with cast iron bearings and a steel shaft, because inadequately lubricated, froze the shaft to the bearings and had to be taken out of service to have the shaft drilled out. Mr. Clark also spoke of the disruption in plant operation during the pear packing season when hydrochloric acid solution was used to wash the lead arsenic spray from the pears prior to shipment. This, in an amount of 300,000 gallons per day, effected a reduction in pH in the incoming sewage from a normal of about 7.2 to 6.0.

CLYDE C. KENNEDY, for the engineers, prefaced his remarks by stating that the operator and everyone else

held the designing engineer responsible for all time for whatever appeared in the sewage at any time and for whatever transpired in the subsidence and aeration tanks or any place else in the plant; that no one short of a seventh son of a seventh son could predict what changes might take place from time to time in the character of the incoming sewage. Mr. Kennedy added, that as long as plants were designed, a large measure of dependence would have to be placed upon the operator for ironing out inconsistencies in plant operation as they developed. He stated that while it was comparatively easy for engineer or operator to "second guess," it was extremely difficult to make all of the right predictions in advance when it came to dealing with materials like sewage and trade wastes.

FRANK CURRIE of Currie & Currie, Engineers, San Bernardino, followed Mr. Kennedy and described what, in his mind, constitutes an ideal plant operator. He stressed four points: first, the operator should be alert and energetic; second, personally neat and clean; third, must have a love for machinery; and, fourth, an ability and disposition to keep good records.† He spoke of twenty plants which his firm had erected in California. At only three of these had there ever been an attempt made to beautify the plant grounds or keep the plant buildings and equipment in first-class shape.

Couched in plain terminology, his statements forcefully presented the dangers involved in the handling of charged electrical equipment and he quoted Steinmetz to the effect that whenever one removes a fuse from a fusebox he first puts one hand into his pocket, removing the fuse with the other hand so that there will be no possible danger of grasping a pipe or other object, thereby completing a current through his body. His thirty-five years of practice as an electrical engineer, he stated, had left him with a great fear of and reverence for electricity and he said that the man with that fear will probably live to read the obituary notice of the one without it.

"Bacteriology in Relation to Sewage Disposal," by RAY L. DERBY, Assistant Sanitary Engineer, Los Angeles Department of Water and Power.

Mr. Derby's paper classified the various bacteria into groups according to their mode of living, their reaction on various substances and on other organisms. It was shown that proper sewage treatment, including production of a satisfactory effluent and a stable well digested sludge, was dependent upon the type of bacterial flora grown. For the production of a well oxidized effluent that will produce no odor in a stream, or other body of water, the aerobic oxidizing bacteria are preferred over other types. A large supply of air is necessary for their satisfactory growth.

(1) *Manager of San Jose and Host, C. M. Goodman and H. A. Mason, First Pres. California League of Municipalities;* (2) *"Chet" Gillespie;* (3) *Petaluma's City Clerk;* (4) *"Steve" Stevenson (Los Angeles);* (5) *Albert Castro (Santa Clara);* (6) *Austin Burt (Ontario) and Carl Hoskinson (Sacramento).*

HAROLD GRAY of Berkeley, following Mr. Currie, stated as his opinion that experienced and older plant operators would do well to employ as their assistants young university graduates in sanitary engineering and from them absorb their modern knowledge of the science and profit from their youthful enthusiasm. He also commented upon the value of schools for operators.

BEN BENAS of San Francisco threw something of a bombshell into the discussion by citing not only some of his own errors in design, but telling the reasons for them and exactly how they had been corrected by himself and the staff of the City Engineer's office. In an able paper he directed attention to certain misfits in design and their remedy.

No one appeared for the equipment-men. Two, however, had written their comments to the Secretary, extolling the virtues of certain types of sewage plant equipment.

"Electricity for Sewage Works Operators," by GEORGE A. WEBER, Palo Alto.

Mr. Weber began his remarks with an elementary discussion of electrical currents, how they are generated and what happens when they are put to work. He then applied this fundamental knowledge to the electrical prime movers in a sewage treatment plant, stressing the need for careful observation and care of automatic load release and cutout switches and concluded his statement with a discussion of fuses—issuing a definite warning regarding the handling of charged lines.

†[Mr. Currie might have added that he must be inherently honest and have something of a streak of curiosity as to what a change in operating technic might turn up.—Ed.]

The carbon, nitrogen, and sulphur cycles were briefly explained and examples of their application to sewage treatment were given. The effect of temperature and proper acidity or alkalinity of solution and its effect on satisfactory sludge digestion and gas production were dealt with. The longevity of various pathogenic organisms present in sewage was discussed and it was shown that the proper digestion of sludge and the satisfactory dilution of effluent, and the natural antagonism of other organisms present in the diluting water, would render most well clarified and oxidized effluents reasonably safe so far as health hazard was concerned. The higher bacterial types were briefly mentioned and their effect on certain treatment processes was also discussed.

"Uses of Activated Sludge Plant Effluent in Golden Gate Park, San Francisco," by PROF. CHAS. GILMAN HYDE, Department of Sanitary Engineering, University of California.

Golden Gate Park in San Francisco, containing something over 760 acres, has been wrested from the sand dunes, once shifting about in the area in which the park is now located. The cry in the park has always been for water and more water for irrigation purposes and for humus and more humus with which to stabilize the sand. The solution of the first need has been found in the construction and operation of an activated sludge sewage treatment plant, while much of the fertility of the soil has been derived from street sweepings. Thus, today this beautiful park, which is second to none in this country in the magnificence of its buildings and appointments and the beauty of its foliage and winding road-

ways, is largely the product of the reclamation of two otherwise wasted materials.

Professor Hyde stated that early in the present century, irrigation with crude sewage was practiced in the unoccupied portions of the park; that by 1926 the Park Commission commenced an investigation regarding the merits of actually reclaiming from sewage, the water for use throughout the park and the digested sludge for use as fertilizer. In 1932 they built and commenced the operation of a one mgd. capacity activated sludge plant. The plant was built by distress labor, using hand-broken stone in the manufacture of concrete. Its cost was $85,000. The annual operation cost is $7,500 and the total annual charges, including all fixed charges, is $15,000. The plant now produces an average of 500,000 gallons per day at a cost which is about 50 per cent of the present San Francisco water rate. With an average suspended solids load of 450 parts per million and B.O.D. values of 325 in the influent, the plant produces an effluent containing approximately 20 parts per million suspended solids; B.O.D. 15 parts per million, and dissolved oxygen 0.3 to 2 parts per million. Twenty-eight pounds of chlorine daily are added to the effluent. Altogether 173 samples have been bacteriologically examined. The quality of the effluent has improved year by year and so far the 1937 analyses have failed to show contamination or pollution in any one of any set of samples analyzed. The present effluent fulfills to all intents and purposes, the standard requirements for drinking water.

Plant effluent is pumped to the uppermost of a series of artificial lakes; thence the water flows over cascades, through rivulets and a series of chain lakes to the westerly lake, where it is recovered for irrigation water. Sludge from the digesters is air dried, pulverized and used in floriculture throughout the park. So successful has been the operation of this plant that the city of San Francisco is now considering the installation of a larger plant for similar purposes.

"Supervision of Sewage Disposal Plant Operation by the Designing Engineer," by G. A. PARKES, Assistant Engineer, City of Los Angeles.

Mr. Parkes led into his subject by first noting all of the various steps by means of which the designing engineer became aware of the functions which a treatment plant would be required to perform. Civic consciousness, nuisances or menace to health, character of sewage, population and industry trends, degree of treatment required, etc.—following which he stated as his impression that, being aware of all of these factors and having designed the plant accordingly, it was poor business to immediately turn the completed structure over in its entirety to another to operate—rather that the designer should be required to "break in" the works and at the same time school the operator in his duties, general and specific, giving freely of his knowledge both as to the plant in question and the process involved. The speaker felt that the designer should, in effect, assume the role of Plant Superintendent and Chief Operator for a period of about a year and should get right down to brass tacks on the job; that such practice would result in closer cooperation between the engineer and operator and most certainly be of mutual benefit.

Mr. Parkes closed by remarking that there were many sewage treatment plants yet to build and that one of the surest ways to improve them was for the designer to be thoroughly familiar with the operator's problems and for the operator to have a thorough understanding of the plant facilities and processes as well as its background.

"Charges for Sewer Connections from Outside Areas to City Sewer Systems," by JEAN L. VINCENZ, Fresno.

After calling attention to the difficulties involved in cesspool disposal of sewage in suburban areas surrounding incorporated cities, Mr. Vincenz directed attention to the extreme health hazards involved not only to the occupants of the suburban areas but also to citizens in the adjacent city, stating in effect that epidemics and germs do not recognize geographical lines and that the citizens of the city were as much endangered as those who contributed the menace to health by poor sanitation. He stated that the objective was to provide adequate sanitation for built-up areas contiguous to cities where, in the latter, there exists a sewer system and disposal works; but that the great stumbling block was a desire on the part of suburban dwellers to avoid annexation to the city, while at the same time enjoying many of the benefits which a municipality afforded its residents.

He felt that, while in a number of California cities, county health officers are militant and aggressive, insisting upon adequate sanitation for suburban dwellings, there are many who are lackadaisical and who do not discharge their duties in a competent manner.

Further contributions to this topic by the City Engineers of Long Beach, Palo Alto, Los Angeles and San Jose, described experiences in those four cities indicating what, under the law, might be done and what measures had proved effective. In each instance it was apparent that the hazard to the city, surrounded by a suburban development with poor sanitation, was the major influence in causing the cities to stretch every point of law and make every conceivable concession to permit of adequate sanitation in its environs; that they were willing to go to almost any extreme to make connections possible for neighbors who were living under insanitary conditions.

At the meeting's close R. F. Goudey, president-elect for 1938, pledged himself and his administration to advancement of the operators' status. He extended the Association's gratitude to E. A. Reinke, retiring president, who has continuously served the Association in some official capacity since its formation ten years ago.

▼

Reeves J. Newsom Enters Consulting Field

Forms Association with J. C. Harding

Reeves J. Newsom announces his entrance into the consulting field and his retirement as President of Community Water Service Co., and its forty odd subsidiary companies of which he has been the operating and engineering head since 1926.

Reeves Newsom

Prior to that time Mr. Newsom spent twelve years in municipal work and was Commissioner and Chief Engineer of the Lynn, Mass., Water Department for eight years. Active for many years in the American Water Works Association, he is now a Director and member of its Executive Committee

Mr. Newsom has established an office at 500 5th Avenue, New York, and has formed an association with James C. Harding who has been practicing as a consulting engineer for the last ten years. They will specialize in water works and sewerage. Mr. Harding will continue his office at Mt. Kisco, N. Y.

The Editor's Comments

The Industrial Waste Picture

ON the closing day of the annual meeting of the American Public Health Association in New York City this month an impressive symposium staged, in a special joint session, dealt with the matter of "Industrial Wastes." This symposium, sponsored by the Public Health Engineering Section of A.P.H.A. and the Federation of Sewage Works Associations, consisted of a program of papers and discussions contributed by representatives of the New England, the New York State and the New Jersey associations of the Sewage Works Federation.

Following the industrial waste symposium an allied subject was dealt with, the disposal of the by-product (waste) from the treatment of sewage—namely, SLUDGE. "The Value of Sewage Sludge as Fertilizer" constituted a comprehensive and worthy compilation of existing practices in respect to the preparation and marketing, or otherwise disposing of sewage sludges. It was presented in the form of a report of A.P.H.A.'s Committee on Sewage Disposal, and constitutes an addition to the several valuable reports developed in previous years by this prolific committee headed by Langdon Pearse of Chicago.

In the symposium, "The Effects of Industrial Wastes on Sewage Treatment" were recounted by Almon L. Fales and Arthur D. Weston, representing the New England Association; "A Survey of Recent Developments in the Treatment of Industrial Wastes" was presented by Dr. Wm. Rudolfs, representing the New Jersey Association, and Dr. Chas. R. Hoover of Connecticut; "Practical Methods of Preventing Dairy Waste Nuisance" were discussed by Chas. C. Agar, representing the New York Association.

The audience heard how industrial wastes had played havoc with public sewers and biological sewage treatment processes; how, in Massachusetts, regulations had to be set up to control the use of public sewers by industry—in one situation a special industrial sewer having had to be constructed at a cost of $2,000,000. On the other hand, it was reported by Dr. Rudolfs that the trend was in the direction of municipalities taking into public sewers and handling in the local treatment works the maximum permissible quantities of industrial sewages. Likewise, that the treatment of industrial wastes when done alone was the more complicated and, in most cases, required combinations of chemical and biological processes to do an acceptable job. Seemingly, Dr. Rudolfs and Dr. Hoover were substantially in greement that there are advantages to be had in the scheme of treating mixtures of industrial wastes with diluting and modifying domestic sewages, rather than attempting treatment of many of the wastes alone.

In respect to the widespread problem of disposing of wastes from dairy products plants, Mr. Agar revealed that such wastes have only been successfully handled in municipal treatment plants, depending upon biological processes alone, when the volume of milk waste does not exceed 10 per cent of the total sewage flow.

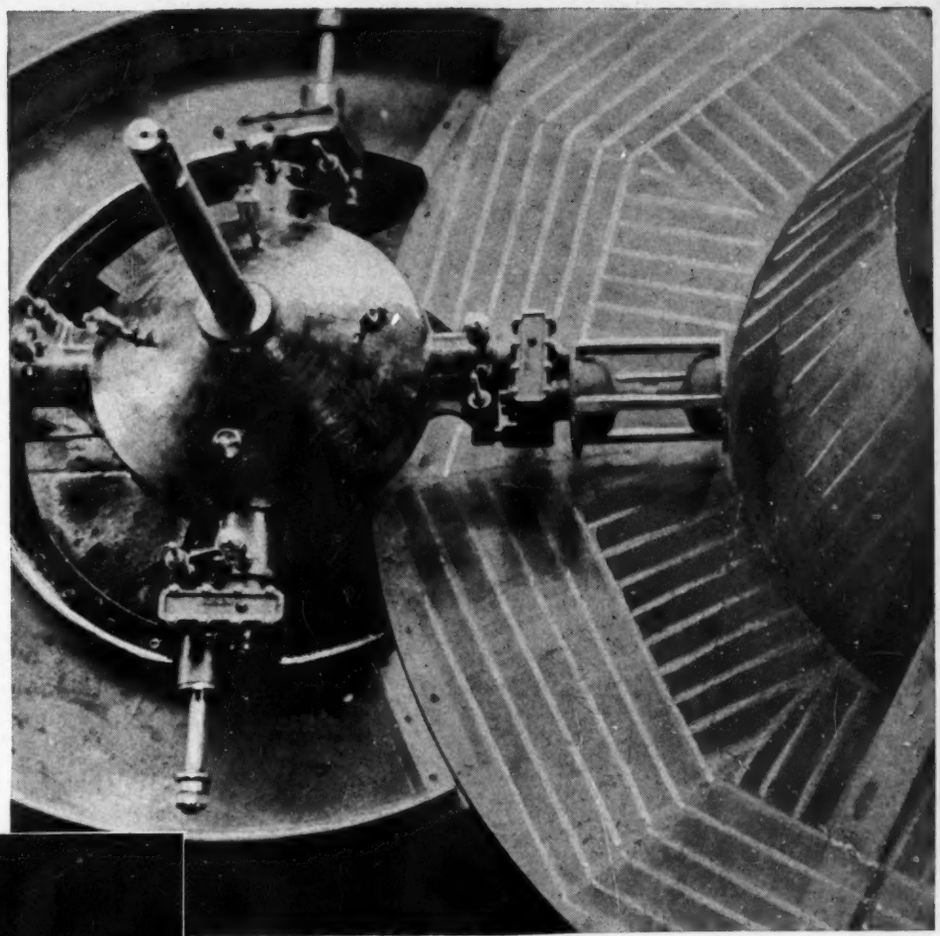
Aside from toxic properties, and effects therefrom on streams and sewers, Dr. Rudolfs pointed out the high relative weight of oxygen demand created by industrial sewages for the country at large, as compared to that of domestic sewages. Specifically, in New Jersey preliminary surveys reveal that industrial sewage outweighs the total domestic sewage in being equivalent to a contributing population of 3,000,000 people, whereas the total population of the state is but 4,000,000.

Concerning methods of dealing with the industrial waste situation and methods of abatement there have been two schools of thought. The first would prohibit industry from utilizing public sewers for the disposal of its wastes. Or, else, industry would be required to construct and operate treatment facilities sufficient to reduce the strength of wastes to that approximating crude domestic sewage, or settled sewage of high strength, before discharge into public sewers. The second school would have industry give its waste only the degree of treatment required to remove or neutralize materials of a sewer choking or sewer damaging nature and provide the remaining treatment, along with the domestic sewage, at the local treatment works. In the latter case an important consideration has been storage and regulated discharge of such wastes so as to provide more nearly uniform hour-to-hour loadings on municipal sewers and treatment plants.

It has been our observation that the objectives of those who would have several industrial establishments in a community provide fairly complete treatment, in as many separate plants, have met with no appreciable success. Furthermore, the scheme has always appeared to us to lack considerably in practicability on technical grounds as well as from the economic and political angle. It is interesting that two authorities taking part in the joint symposium seemingly agree that the major job can most effectively and easily be done on most wastes if diluted with sewage. This presumedly means that in most instances the point of attack is properly at the site of the local sewage treatment plant, and involves the adaptation of some form of pre-treatment or combination treatment at the municipally operated plant.

In this issue appears the second of a series of articles descriptive of the pioneering combination treatment works of Cedar Rapids, Iowa, along with operating results attained. The plant was designed in two units—one being the industrial waste pre-treatment plant, delivering its effluent for admixture with the settled domestice sewage receiving secondary treatment on trickling filters. In addition to the fact that the scheme has proved wholly practical as designed, it is of considerable interest to note that maximum economy (with sufficiency) has come from nothing more than pre-treatment by mechanical flocculation, without the benefit of coagulating chemicals. It has been possible, therefore, to operate without coagulant until such time as the load increase demands a higher degree of sewage preparation for the biological end of the plant.

In considering the operation of municipally operated combination treatment works, the question which naturally arises is—"Who pays the bill?" In some localities the industrial establishment may be sufficient of a contributor of taxes to justify the financing of the combination treatment from the tax fund. In other instances, it seems more reasonable to expect the establishments served to stand the actual out-of-pocket costs to the municipality when more than one establishment is so served, then, on a pro rata basis. Such a scheme has been successfully worked out and put into practice at Canton, Ohio, as recounted by Chas. C. Hommon in the February, 1937, issue of this magazine. There are municipalities which are now experiencing troubles from sewer destruction or plant overloading. Others have had troubles and have put in necessary treatment, either up sewer or at the municipal plant, and have assessed industry the costs.



ANACONDA

Shop assembly view of 12-foot EVERDUR sewage disc screen with revolving brush mechanism (brush staves not shown). Designed and furnished by Krajewski-Pesant Mfg. Corp., New York City, for the Stafford Springs, Conn., Sewage Treatment Works.

FOR 10 YEARS

EVERDUR* Silicon Bronze has proved itself in sewage treatment service

Since 1927, for coarse and fine screens, gates, aprons, weirs, and many other sewage treatment applications, Everdur Metal has demonstrated that it has exceptional advantages.

Steel-like strength and high resistance to corrosion are of course of first importance. But in addition, EVERDUR Metal is fabricated so easily, and is so reasonable in cost, that it is acknowledged by many authorities to be in a class by itself for sewage treatment service. EVERDUR is available in all commercial forms. Let us send you complete information. Ask for Publication E-11.

*"Everdur" is a trade-mark of The American Brass Company, registered in U. S. Pat. Off. 37388

RUSTLESS AS COPPER
STRONG AS STEEL

Everdur Metal

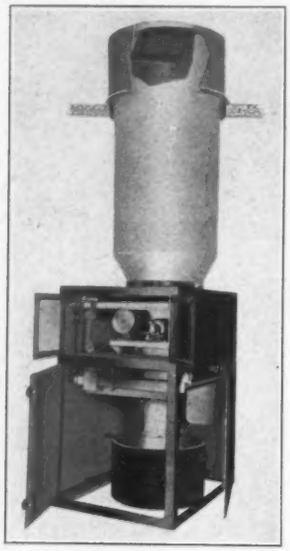
THE AMERICAN BRASS COMPANY · General Offices: Waterbury, Connecticut

Offices and Agencies in Principal Cities · In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

EQUIPMENT NEWS

Omega Combination Scales and Feeder

Omega Machine Company, of Kansas City, have recently developed the combination cabinet model chemical feeder and weighing scales here pictured. This neat enclosed unit has been designed as a complete unit to serve those plants in which the feeding of small quantities of chemicals may not warrant the expense of installing the precision gravametric-type



Omega Combination Scales and Feeder

feeders, which feed by exact weight control rather than calibrated volume control.

The new feeder and scale mechanism is designed for easy filling of the hopper, ready inspection and ease in checking of weight and feeding rate. It has a large capacity solution chamber of typical Omega design. The combination unit of feeder and weighing scales has been especially designed to allow for relatively inexpensive addition of the necessary control equipment to later convert the unit to a weight-control gravametric feeder, when desired. At the same time a recorder can be attached which produces a charted record of rates of feed at all times, time of refilling the hopper, weight added, and weight fed between fillings.

For new descriptive catalog pages giving detailed specifications covering the Combination Cabinet Universal Feeder, write Omega Machine Co., 4010 Penn Ave., Kansas City, Mo.

▼

Compact Two-Stage Pump

Fairbanks, Morse & Company, Chicago, have developed a "Built-Together" Pump, of two stages, to operate against heads up to 500 ft. As the name signifies, and illustrations reveal, the pump and motor are built together — the pump having first and second stage enclosed bronze impellers placed *back to back* to compensate thrust.

Fairbanks-Morse 2-Stage Pump

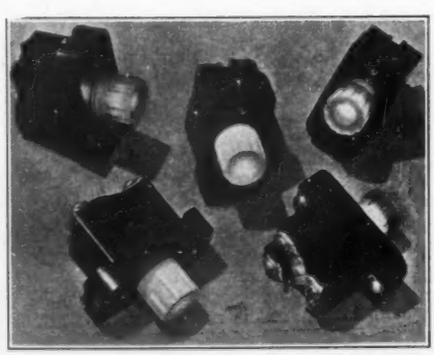
An attainment in improved hydraulic design has been secured by placing the low stage impeller next to the motor and the high stage impeller on the outside, simplifying the cross-over passage, and placing the stuffing box under suction rather than pressure. There are no flexible couplings and the built-together pump-motor unit can be mounted in horizontal, angular or vertical position without any problem of alignment to contend with. Two rugged ball bearings, successfully pioneered by Fairbanks, Morse & Co. some years ago, take all radial or unbalanced thrust load. The motor of splash-proof design is also a F.-M. unit.

The improved F.-M. Built-Together pump unit is adapted to all classes of water pumping service. In many applications, it will serve as a less expensive alternate for multi-stage and split-case pumps. They are especially recommended for booster station service, boiler feed, or fire service. An effectively illustrated descriptive bulletin (No. 5592) is available. For a copy, or for further information, address Fairbanks, Morse & Co., 900 S. Wabash, Chicago, Ill.

▼

Illuminated Push-Buttons

As a further aid to machine operators, General Electric has developed a new small standard-duty push-button station with an indicating lamp within the translucent button. Through the combination of the push-button and indicating lamp in a single compact unit, the new station is proving popular because it needs only about one-half the space required by the two devices when they are mounted separately. It is available with buttons in six colors: white, green, blue, red, clear, and amber.



Illuminated Push-Button

The indicating lamp is operated through a small control transformer which, because of its diminutive size, can be mounted readily in or on a machine. An idea of the compactness of the push-button station can be gained from the fact that it is but 2⅝ inches high, 1¼ inches wide, and 2⅝ inches thick.

For further information address "G. E.," Schenectady, N. Y.

▼

"Metallizing" Metal Plating by Air Gun

"Metallizing" has seemingly proved the claims of its inventors and sponsors in its growing ramification of uses and adaptations in industry. Only a few years ago it was a novelty. To wit: we saw in California an interesting pair of bronze book ends, apparently perfect reproductions of a pair of wrinkled and worn baby shoes, of the treasured sort. We learned that, they were, in fact, just that and the old shoes were actually there. The leather had been completely bronze "plated" by a novel process known as "Metallizing." We learned that the metal had been evenly atomized on, through use of a bronze wire fed automatically from a reel to the nozzle of the metallizing high pressure air gun. Passing through these 2¾ to 4 lb. guns held in the operator's hand the wire, fed at a desired rate of speed, was instantaneously liquefied by the heat of the self-contained oxy-acetylene jet. The result was metallic "steam" or mist, which cast at high velocity against the cool object there condensed into a solid metal film, just as one would ice-plate with mist or steam against any object below the solidifying point of water vapor. In it there was novelty and intrigue.

Now, we learn of the many subsequent and highly practical applications of "metallizing" in a variety of renovating and salvaging operations in industry. Interesting are the uses to which "Metallizing" is being put to replace zinc galvanizing, tin plating; for building up worn, pitted or damaged surfaces of metallic parts with wires of low carbon steels, phospor bronze, stainless steels, etc.; for renovating machine elements in particular. Many industrial plants have been equipped for "Metallizing"; many cities have repair shops now able to salvage equipment by the "Metallizing" process. In a recent 36 page booklet the process is described and a miscellany of applications are illustrated—from bronze plating baby shoes, to the lining of steel water tanks by the Erie, Pa. Water Department, to the aluminum coating of sea-planes, to re-zincing hull plates of Uncle Sam's fleet "sea-dogs." It's an intriguing process described in an interesting booklet. For a copy of suggestive "Metallizing," address—Metallizing Company of America, Inc., Arcade Station, Los Angeles, Calif.

This time-down HOUSTON way!

Right up with ditcher was this 30" Dresser-coupled water line, as both neared their goal —Champion Paper & Fibre Company's new mill near Houston, Texas.

HERE, THERE, EVERYWHERE!

Dresser Couplings are "going places," geographically. For instance:

Buffalo, N.Y.
Kalamazoo, Mich.
Milwaukee, Wis.
Nederland, Colo.
Omaha, Neb.
Ottawa, Can.

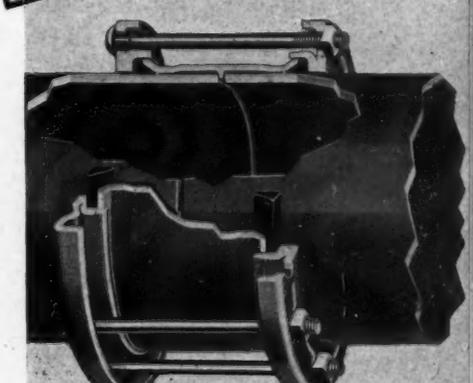
This 30" well-water line, along the Houston ship channel, had to pass under numerous highways and railroads to reach a new paper plant*, 11 miles from Houston. Easily constructed with unskilled labor, the line gave a perfect performance on the first test. It is completely Dresser-coupled.

*Additional Dresser joints were used on the inside piping of above mill. A further order for more 30" couplings has since been received for extension work.

FIVE REASONS WHY MODERN WATER LINES ARE DRESSER-COUPLED:

1. PERMANENT TIGHTNESS—proved for 50 years, on 150,000 miles of pipe.
2. FLEXIBILITY—normal pipe movements—present in every line—are absorbed.
3. SIMPLICITY—joints are "factory-made"; ordinary labor can install.
4. STRENGTH—predetermined; joints safely withstand any specified pressure.
5. TRUE ECONOMY—a truly lower joint cost throughout the life of the line.

Write for our General Catalog No. 36.



Cutaway view of Dresser Style 38 Coupling, showing working principle. Note that plain-end pipe is used. The resilient gaskets, flexing with the pipe, safely absorb pipe movements.

THE MODERN TREND IS TO DRESSER COUPLINGS

S. R. DRESSER MFG. COMPANY, BRADFORD, PA. • *In Canada:* Dresser Mfg. Company, Ltd., 60 Front St., W., Toronto, Ont.

% CHEMICAL FEEDERS %

Entrance to Sewage Treatment Plant, Elmira, N. Y.

Proportional Dry Feeding and Automatic Lime Slaking —at Elmira

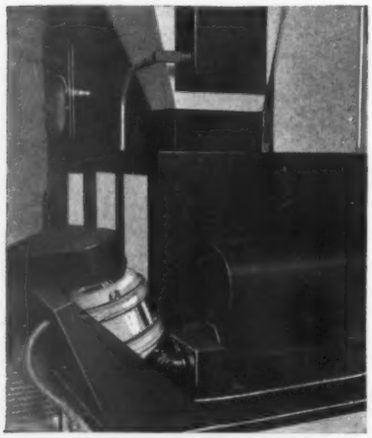
%Proportioneers'% Ferr-O-Feeders and Chlor-O-Feeders (the "little red pumps") have made friends everywhere. Other members of the %Proportioneers% family are just as worthy of mention.

For instance, users swear by the results obtained by their %Proportioneers'% Automatic dry feeder and lime slakers (illustrated below)—feeding accurately in proportion to flow of liquid being treated!

IMPORTANT!

Engineers and designers are sensing more and more that %Proportioneers% chemical feeding equipment is flexible in the extreme: ANY chemical, liquid or solid; at constant rate or in proportion to flow—it's all in the day's work AND THE SET-UP RECOMMENDED WILL BE ECONOMICALLY SUITED TO THE JOB!

Write for NEW Bulletin No. "RED"



% PROPORTIONEERS % Inc.

Associated with Builders Iron Foundry

9 N. Codding Street

PROVIDENCE, R. I.

International Offers Sewage Equipment

International Filter Co. of Chicago, well-known manufacturers of water treatment equipment, have recently announced a line of sewage treatment equipment. Amongst such are the Infilco Activator and Infilco Rotary Distributor and Dosing Syphon.

The Infilco Activator mechanism, here illustrated, provides mechanical aeration and recirculation in the activated sludge process. It consists of a vertical motorized reducer, an impeller located at the surface of the liquid, a stationary up-draft tube at the tank center. In operation, the impeller creates surface splash aeration, and a spiral mix and effective displacement, by throwing out mixed liquor horizontally from the top of the center draft tube. Thereby up-flow in the tube is created and effective recirculation from the bottom of the tank across the surface results.

A unique adjustment feature is incorporated which makes it feasible to compensate for variations in load and thereby effect economy. Suitable effluent weirs maintain a liquor surface at ½ inch above or below a median flow line. A readily adjusted submergence of the impeller, to vary rates of turn-over to meet the loading conditions, is had by a screw and adjustment linkage which raises and lowers the drive motor to change the impeller submergence without slowing down operations. Another feature is the design of the impeller with inner edges of the blades curved to avoid accumulations of fibrous materials.

In another bulletin received the features of Infilco Rotary Distributors and Dosing Syphons are illustrated and described. For a copy of Bul. 2421—The Activator; or Bul. 2410—Rotary Distributors & Syphons, write International Filter Co., 59 E. Van Buren St., Chicago, Ill.

▼

Sam Hamilton Made District Sales Manager

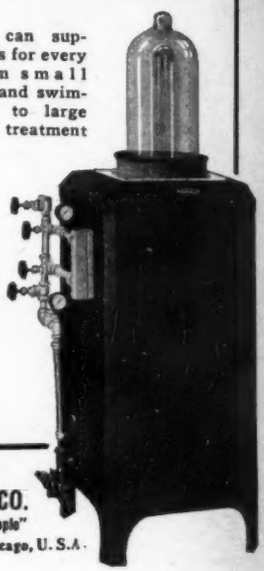
S. C. Hamilton

Chicago Bridge and Iron Co., of Chicago, announce that S. C. Hamilton has been made District Sales Manager of the Birmingham territory. Mr. Hamilton came to Chicago Bridge and Iron Co. after graduation from Iowa State College in 1928. He spent the first two years in the Engineering Department in Chicago, and on erection work in the field. Since 1930 he has been attached to the Birmingham Division. Well known and popular in his territory Sam has made many friends for his company. And, what else he has accomplished in the Sales Division is attested by his deserved promotion to district Sales Manager.

Announcing The New EVERSON Type "R" Chlorine Sterilizer

HERE at last is the perfect chlorine sterilizer featuring the exclusive EVERSON *micro-control*, absolutely accurate feature, combined with the other proven EVERSON features including: Automatic Gas Absorber, Automatic Venting, and the Automatic Vacuum Break which protects against Back-Flooding.

EVERSON can supply capacities for every need—from small water works and swimming pools, to large sewage treatment plants.



Write for New Bulletin

EVERSON MFG. CO.
"The Swimming Pool People"
233 W. Huron St., Chicago, U. S. A.

▼

Merrimac Chemical Establishes Water and Sewage Chemicals Division—Jerry McCarthy in Charge

J. J. McCarthy

With the addition of the new coagulant "Ferrisul" (anhydrous ferric sulphate) to its list of chemicals used in treating water and sewage, Merrimac Chemical Company has formed a Water and Sewage Chemicals Division.

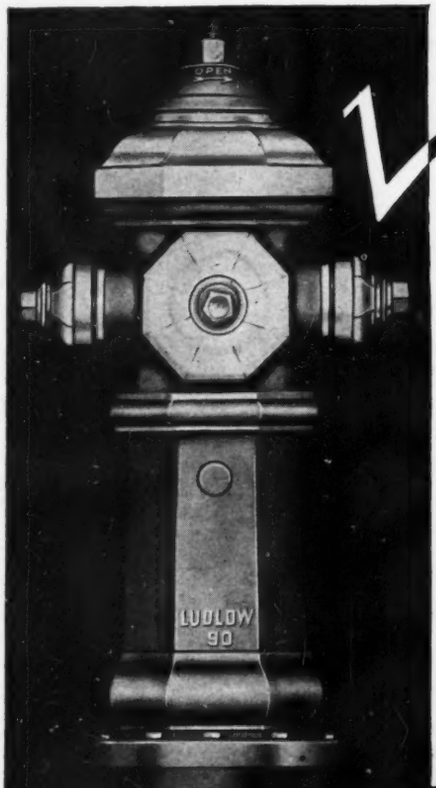
The work of this new division is under the direction of Justin J. (Jerry) McCarthy, who has been with Merrimac for 16 years. His assistants are Roy T. Cowing, Francis K. Burr and Donald C. Douglas, all of whom are engineering graduates with special training and experience in work of the nature which is to be handled by Merrimac's Water and Sewage Division.

"WHENEVER AIR ACCUMULATIONS Are to Be Automatically Vented SPECIFY SIMPLEX"

•

Write for Bulletin 58.

SIMPLEX VALVE & METER CO.
6743 UPLAND STREET • PHILADELPHIA, PA.



✓Check LUDLOW Hydrants

Check these points about the Ludlow No. 90 hydrant—

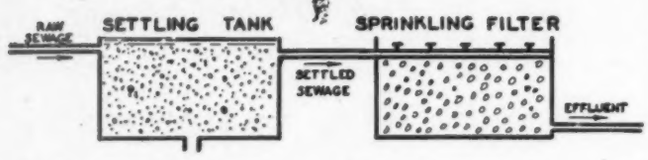
- ✓ **Full force—no obstruction in waterway**
- ✓ **Non-freezing—drains from bottom**
- ✓ **Surge and water hammer eliminated**
- ✓ **Replaceable without digging**
- ✓ **Parts easily removable—low maintenance**

— and finally, the most modern, graceful design obtainable.

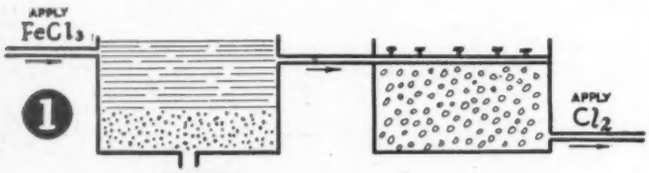
SEND FOR FREE FOLDER

The LUDLOW VALVE MFG. CO.
TROY · NEW YORK

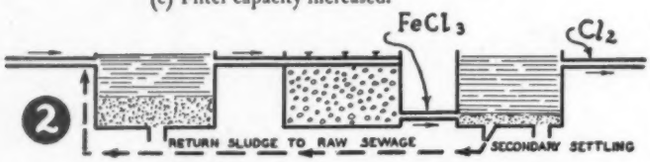
CHEMICAL TREATMENT COULD HELP THIS MUNICIPAL SEWAGE PLANT



This simple flowsheet is taken from an actual municipal sewage treatment plant operating in a small California community. Some dairy wastes are added to the domestic sewage. The plant does a fair job, but it gives off objectionable odors and it does not give a clear effluent. Here are two ways that chemical treatment could help this plant:



RESULTS:
(a) Great reduction in B. O. D. (biochemical oxygen demand) of settled sewage going to sprinkling filter.
(b) Odor reduction at entrance to plant.
(c) Filter capacity increased.



RESULTS:
(a) Much clearer filter effluent.
(b) Odor nuisance greatly reduced.
(c) B. O. D. load on filter greatly reduced.
(d) Overall efficiency greatly increased.

Can chemical treatment help your plant?

Yes—chemical treatment with Ferric Chloride can help any sewage plant consisting of at least a settling tank. If you have more extensive treatment, Ferric Chloride can help you obtain more economical operation. You may not need any additional equipment except an inexpensive applicator. Send us details of your present treatment and we will gladly supply details without obligation.

Liquid Chlorine • Ammonia • Ferric Chloride

GREAT WESTERN ELECTRO-CHEMICAL CO.

9 MAIN STREET, SAN FRANCISCO
PLANT: PITTSBURG, CALIFORNIA
4151 BANDINI BLVD., LOS ANGELES

GREAT WESTERN ELECTRO-CHEMICAL CO. BEAR BRAND PRODUCTS SAN FRANCISCO CALIF.

MEETINGS SCHEDULED:

Oct. 15-16—Elmira, N. Y. (Mark Twain Hotel).
New York State Sewage Works Association. (Fall Meeting.) Sec'y-Treas., Arthur S. Bedell, State Dept. Health., Albany, N. Y.

Oct. 15-16—Atlantic City, N. J. (Hotel Claridge).
New Jersey Section A.W.W.A. Secretary, P. S. Wilson, 325 Washington Street, Glen Ridge, N. J.

Oct. 18-21—Galveston, Texas (Hotel Galvez).
Southwest Section A.W.W.A. (Annual Meeting.) Sec'y-Treas., L. A. Quigley, Superintendent Water Dept., Fort Worth, Texas.

Oct. 18-21—New Orleans, La. (Hotel Roosevelt).
International City Managers Association. Executive-Director, Clarence E. Ridley, 850 East 58th St., Chicago, Ill.

Oct. 19-20—Cincinnati, Ohio (Netherland Plaza Hotel).
Ohio Conference on Sewage Treatment. (Annual Convention.) Sec'y, Bruce M. McDill, Dept. Health, Columbus, Ohio.

Oct. 21-22—Cincinnati, Ohio (Netherland-Plaza).
Ohio Conference on Water Purification. Sec'y, Thos. R. Lathrop, Ohio Dept. Health, Columbus, Ohio.

Oct. 20—Biddeford, Me.
Maine Water Utilities Association. Meeting, 10:00 A. M., Biddeford, Me. Luncheon, Cascade Lodge, Saco, Me. Sec'y-Treas., Earle A. Tarr, Winthrop, Me.

Oct. 20-23—Sacramento, Calif. (Senator Hotel).
California Section A.W.W.A. (Annual Convention.) Sec'y-Treas., C. M. Hoskinson, 1140 43rd St., Sacramento, Calif.

Oct. 21-22—St. Paul, Minn. (Hotel Lowery).
Central States Sewage Works Association. Sec'y, W. H. Wisely, State Dept. of Health, Springfield, Ill.

Oct. 21-22—London, Toronto (Hotel London).
Canadian Institute on Sewage and Sanitation. Sec'y-Treas., A. E. Berry, Chief Engr., Ontario Dept. Health, Toronto, Ont.

Oct. 21-23—Fairmont, W. Va. (Hotel Fairmont).
West Va. Conference on Water Purification. Sec'y, J. B. Harrington, Engr. Division State Department Health, Charleston, W. Va.

Oct. 21-23—Lakeside, Mo. (Holiday House).
Missouri Water & Sewerage Conference. (Annual Meeting.) Sec'y-Treas., A. G. Nolte, State Dept. Health, Jefferson, Mo.

Nov. 1-3—Dallas, Texas (The Adolphus Hotel).
Texas Public Health Association (15th Annual Meeting.) Sec'y, P. A. Kerby, State Board of Health, Austin, Texas.

Nov. 3-5—Ames, Iowa (Iowa State College).
Iowa Wastes Disposal Association. Sec'y-Treas., L. J. Murphy, Ames, Iowa.

Nov. 3-5—Atlanta, Ga. (Georgia Inst. Technology).
Georgia Water and Sewage Plant Operators' School. W. H. Weir, Division of Sanitary Engineering, State Dept. of Health, Atlanta, Ga.

Nov. 4-6—Richmond, Va. (Hotel Jefferson).
Virginia Section A. W. W. A. Secy'-Treas., H. W. Snidow, Senior Assistant Engineer, State Dept. Health, Richmond, Va.

Nov. 4-6—Omaha, Neb. (Fontenelle Hotel).
Missouri Valley Section A. W. W. A. (Annual Meeting.) Sec'y-Treas., Earle L. Waterman, Professor of Sanitary Engineering, University of Iowa, Iowa City, Ia.

Nov. 8-10—Green Bay, Wisc. (Hotel Northland).
Wisconsin Section A. W. W. A. (Annual Meeting.) Sec'y-Treas., Leon A. Smith, Supt., Water Works, City Hall, Madison, Wis.

Nov. 15—New York City (Engineering Societies Building).
Amer. Soc. of Mechanical Engrs. (Special Symposium.) "Sewage Pumps and Pumping"—Leading pump engineers participating. In charge—William Raisch, Cons. Engr., 227 Fulton St., New York City.

March 23-25, 1938—Windsor, Ontario (Prince Edward Hotel).

April 25-28, 1938—New Orleans, La.
American Water Works Association. (Annual Convention.) Executive Secretary, H. E. Jordan, 29 West 39th St., New York City.

CATALOGS AND LITERATURE RECEIVED

[Any of the publications reviewed in this section can be secured from or through Water Works and Sewerage, if such be desirable.]

"Simplex Air Release Valves"—Is an eleven page brochure from Simplex Valve and Meter Company which discusses and illustrates methods of air venting pipe lines and pumps. The various schemes of adopting Simplex Air Release Valves, which open and close automatically to free accumulated air from sewage or water mains, are set forth. The valves, constructed to resist corrosion and insure positive dependable operation are pictured effectively, and described in some detail as to design and functioning. The brochure points out the difficulties created by entrained or dissolved air when released at the most critical points—the summits on pipe lines and the tops of pump casings. For "Simplex Air Release Valves" write Simplex Valve and Meter Co., 68th and Upland Sts., Philadelphia, Pa.

"Victor Model 100 Pumps"—From Victor Equipment Co. has come a bulletin describing the new Victor "100" Sand Pump with the featured Take-up Adjustment, to compensate for efficiency loss, due to wear between the hard metal wear-nozzle and impeller hub. This and other distinctive features of these pumps make them especially adaptable and serviceable in the pumping of water or sewage or wastes containing fine sand, gritty matter, or turbidity of an abrasive nature, which ordinarily creates pump wear and falling efficiencies and capacities. The Victor Wear Take-up Adjusting mechanism and method of operation is described by cross sectional drawings, which likewise reveal other special design features of these punishment-taking pumps. Dimensions and price list tables of complete units and replacement parts are given. For Bulletin 100, write Victor Equipment Co., 515 Harrison St., San Francisco.

"Buried Treasures"—Is the caption of a folder which sets forth the several features of the Mueller-Columbian Fire-Hydrant in easy to read illustrated style. Why "Buried Treasure"—because so much of the hydrant remains under ground for long periods, with little concern as to its value and dependability when needed. A copy of "Buried Treasure" can be had from Mueller Company, Decatur, Ill.

"Experiences with Gas Engine Operation"—From Worthington of Newark, N. J., comes two reprints of worthy articles revealing experiences in the installation, operation and economies resulting from the use of gas engines at sewage works. One is by the pioneering engineer to successfully use gas engines operating on sludge gas in America—W. B. Walraven of Springfield, Ill. The other reprint tells of the Dallas, Texas, installation for pumping sewage. Anyone interested in the progressive method of by-product gas utilization in power development at sewage works will benefit by reading both articles. For copies, write Worthington Pump and Machinery Corp., (Gas Engine Division), Harrison, N. J.

"Rotary Displacement Meters"—Is a new and attractive bulletin from Roots-Connersville Blower Corp., which describes general operating principles of the Rotary Meter, and lists sizes smaller than any in previous bulletins. Typical proof curves, illustrations of advanced meter design and views of representative installations, are shown measuring total sludge gas production and gas consumed by gas-engines. Indicating and recording gas

Bulletin 293

NOW READY

WATER WORKS and SEWAGE PLANT Designers and Superintendents will be interested in Bulletin 293, which contains up-to-the-minute information regarding Venturi Meters. (A companion bulletin to No. 287, "Measurement, Control and Chemical Treatment of Sewage and Sludge).

Of especial interest:

The illustrations and descriptions of the *new* Type M Register-Indicator-Recorders (Model D and Model F).

The discussion of the Chronoflo Meter as used in summing up the total flow of many different instrumenuts.

●

BUILDERS IRON FOUNDRY

"Builders of the Venturi Since 1891"

9 Codding St. Providence, R.I.

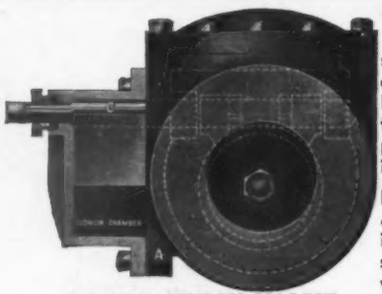
DEPENDABILITY

ALTITUDE VALVE

● ALTITUDE VALVE assures perfect water-level control in tanks, standpipes and reservoirs.

Always function without any water surge or shock due to efficient air and water cushioning.

Furnished with automatic, electric and manual control, and for single or double-acting service.



SWING CHECK VALVE

● Cushioned Swing Check valve is non-slam due to perfect cushioning chamber. Minimum friction loss through valve and soon pays in power cost savings.

Furnished in all sizes 4" and larger for all service conditions and pressures. Easily equipped with lever for manual control.

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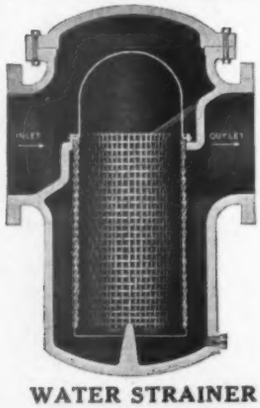
● Float Control Valve for high or low pressure service which can function on any desired water level variation desired. No water hammer or shock due to air and water cushioning.

Furnished in angle or globe patterns ½" to 24" sizes in bronze, iron body or steel. No metal contacts assure lifetime service.



WATER STRAINER

● Clean water constantly assured by the efficient and economical strainer, supplied with any mesh basket of any material to meet the service demands. Easily and quickly cleaned. Designed for maximum capacities with minimum friction loss. Sizes 3" to 24".

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flow instruments are also described in this new bulletin. For a copy, request Bul. 40-B 12 from Roots-Connersville Blower Corp., Connersville, Ind.

"Controls and Control Systems"—A new 48-page condensed catalog and price list has just been issued to cover the variety of "Controls and Control Systems" produced by The Minneapolis-Honeywell Regulator Company, for pressure, heat, gas, water control, etc. It contains a complete arrangement of all M-H controls and control systems, including the new National pneumatic controls and Brown indicating, recording and control instruments. Many items and prices are new. For a copy of "M-H Condensed Catalog and Price List"—write Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.

"Liquid Chlorine"—Is the title of a "hand-book" recently produced by Hooker Electrochemical Company, manufacturers of liquid chlorine. It sets forth the properties, uses, transportation equipment, and safe handling of chlorine. It describes modern methods and equipment for preparing calcium hypochlorite solution from lime and liquid chlorine; chlorination in water purification, sewage treatment; swimming pool disinfection; slime control in condensers and paper products mills. Graphs covering specific properties and chlorine reactions appear and, at the end—handy tables of conversion factors for volumes, weights, areas, power, temperatures. For a copy of the Liquid Chlorine Handbook write Hooker Electrochemical Co., Lincoln Building, New York City; or Tacoma, Washington.

"Dirt Moving"—Is the theme of two new bulletins from Bucyrus-Erie Co., descriptive of their newest 2-wheel and 4-wheel Scrapers (tractor operated), for digging, hauling, dumping and leveling—both are one-man machines, operated by hydraulic power cylinders from the driver's seat on the tractor. For these new scraper bulletins, address Bucyrus-Erie Co., South Milwaukee, Wis.

"Perforated Plates"—From Allis Chalmers Mfg. Co. has been received a bulletin covering perforated metal sheets and plates for all manner of applications and variety of metals in curved or flat plates of various thickness for screens, underdrainage systems, distributors et al. Numerous cuts, to scale, illustrate the variety of shapes and sizes of perforations which can be supplied. Accompanying tables reveal pertinent data for designers or users of perforated plates. If interested ask for Bulletin 1832, "Perforated Metal Plates," address Allis-Chalmers Mfg. Co., Milwaukee, Wisc.

"Pointed Wellpoint Facts"—Is the caption of a new illustrated bulletin descriptive of Griffin Wellpoint Systems; Griffin equipment and appurtances used in dewatering operations in foundation, plant and sewer construction; for sinking concrete piling; for securing water supply. The construction of the wellpoint, jetting and "Interflow" points and strainers is illustrated, as are Griffin "Vac-U-Matic" Pumps. The Griffin System (and equipment) is offered for rental or for sale. For a copy of "Wellpoint Facts" write the Griffin Wellpoint Corp., 725 East 140th St., New York City.

"Building Better Pipe Lines"—Is the title of a new 14-page bulletin, from The Lincoln Electric Co. of Cleveland, which is well done and of interest to anyone having to do with welding in constructing or repairing pipe lines. Welding technic and recommended practices are described and illustrated in many pictures "on the job." Features of "shield-arc" welding are emphasized, and sample specifications and regulations covering welding practice are presented. Then comes a display of up-to-date Lincoln Welders, "Fleetweld" electrodes, etc. The rapid growth of welding in pipe line construction will impress the reader and engineers should find the context informative and of value. For a copy of "Building Better Pipe Lines," write The Lincoln Electric Co., Cleveland, Ohio.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF MARCH 3, 1933

Of Water Works and Sewerage, published monthly at Chicago, Ill., for October 1, 1937.

State of Illinois, County of Cook, ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared E. S. Gillette, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the Water Works and Sewerage and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher—Gillette Publishing Company, 400 W. Madison St., Chicago, Illinois.

Editor—L. H. Enslow, 155 E. 44th St., New York City.

Managing Editor—C. T. Murray, 400 W. Madison St., Chicago, Illinois.

Business Manager—E. S. Gillette, 400 W. Madison St., Chicago, Illinois.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.)

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H. P. Gillette, 400 W. Madison St., Chicago, Illinois.

E. S. Gillette, 400 W. Madison St., Chicago, Illinois.

Winifred Gillette, 1125 Oak Grove Ave., San Marino, Calif.

Mrs. R. W. Hume, 303 S. Stone Ave., La Grange, Illinois.

Provident Trust Company, 17th and Chestnut Sts., Philadelphia, Pa.

Louise Forsythe, 13 E. Windemere Terrace, Lansdowne, Pa.

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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is ——. (This information is required from daily publications only.)

EDWARD S. GILLETTE,
Business Manager.

Sworn to and subscribed before me this 30th day of September, 1937.

(Seal)

KITTIE C. WOULFE,
Notary Public.

(My commission expires Feb. 8, 1938.)

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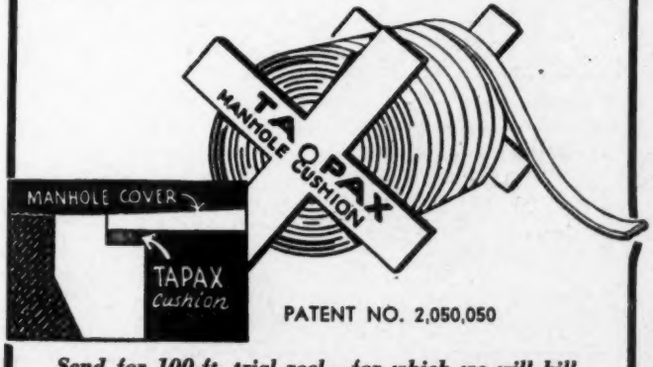

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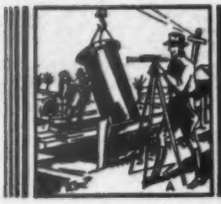

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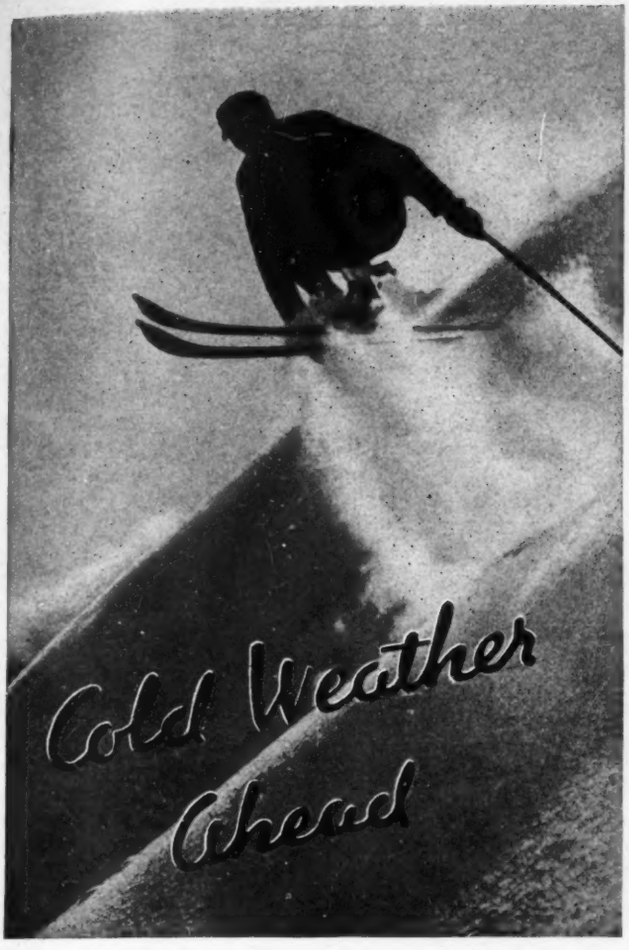

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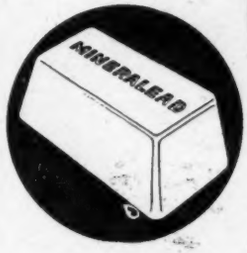

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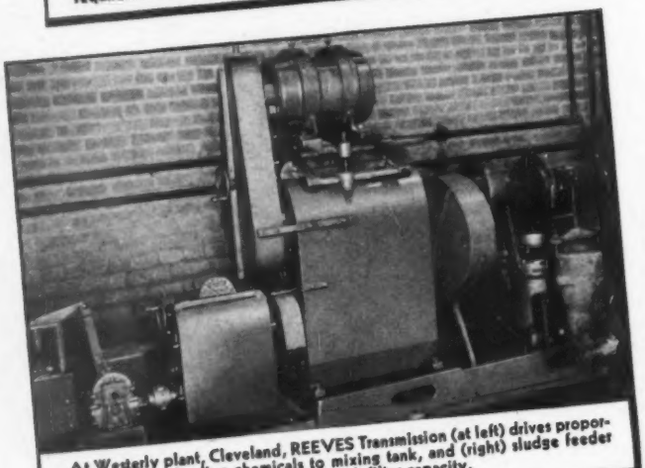

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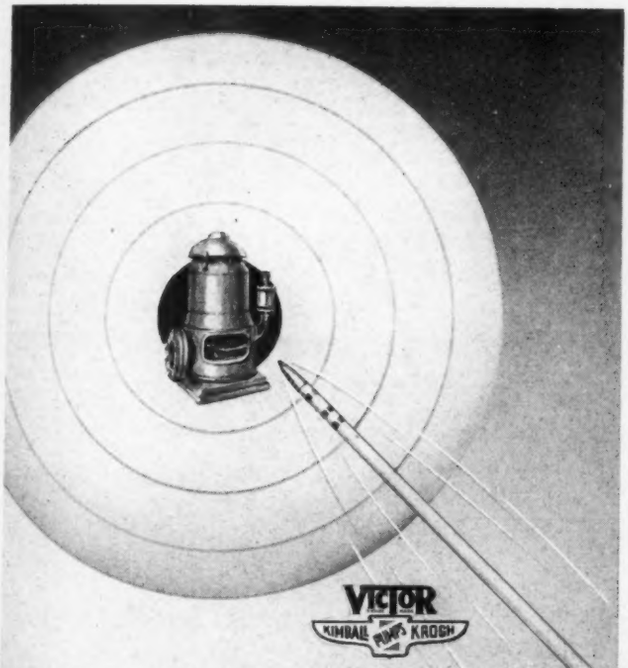

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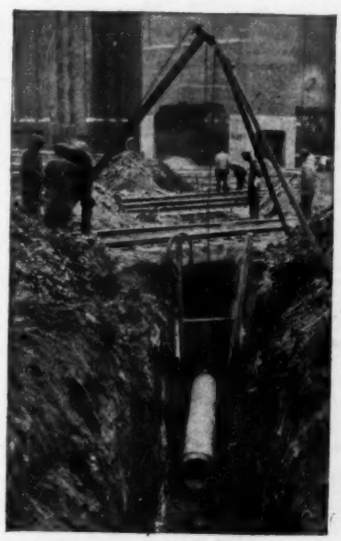

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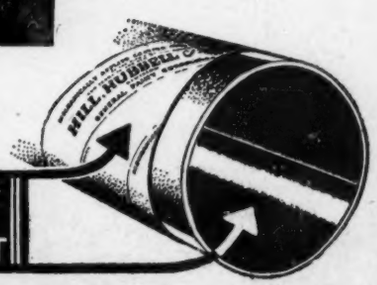

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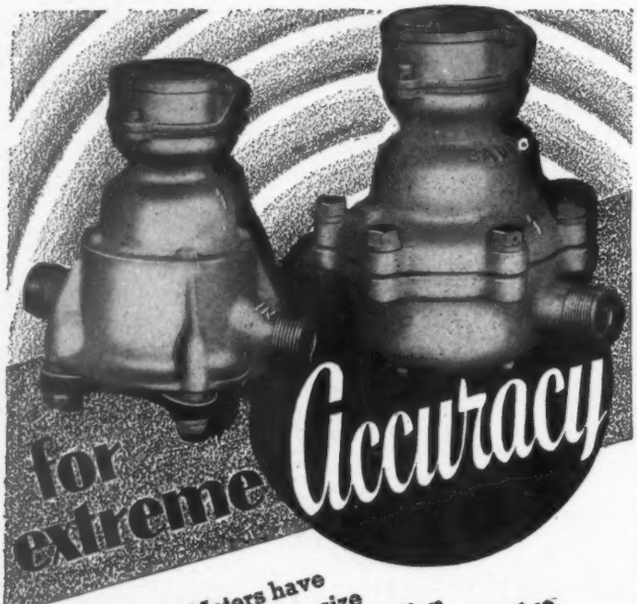

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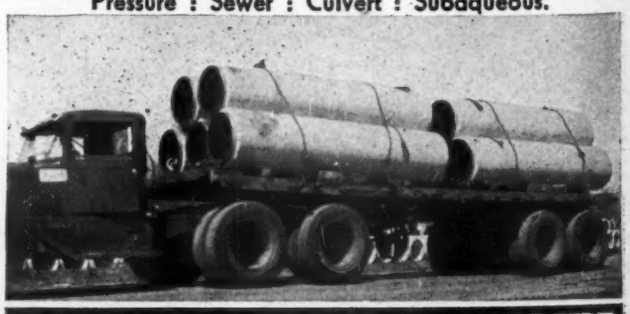

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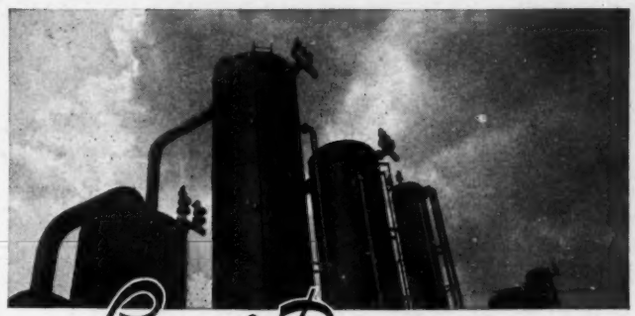

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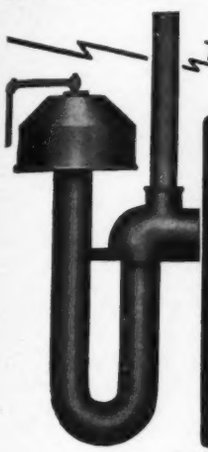

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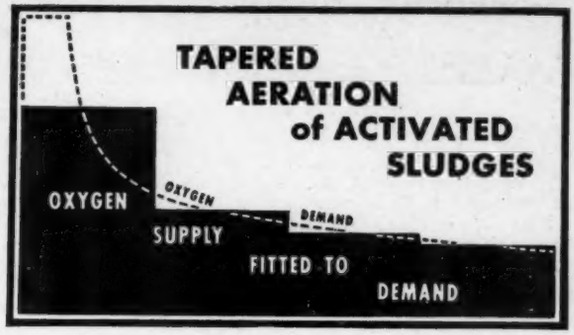

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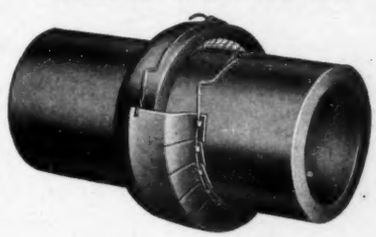

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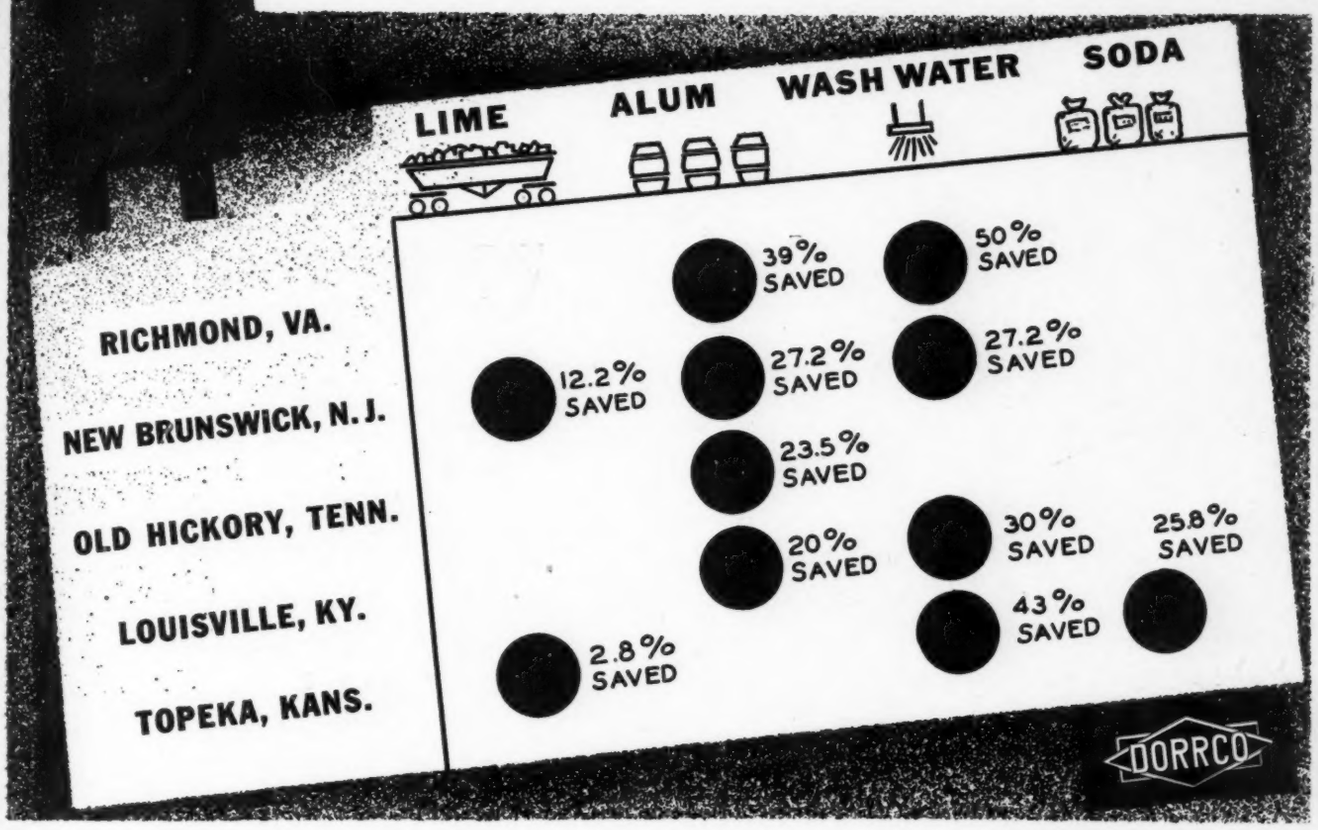

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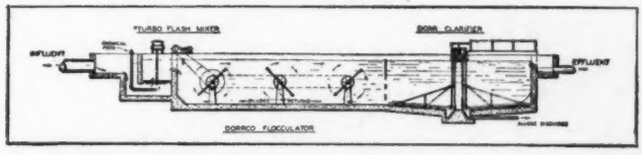

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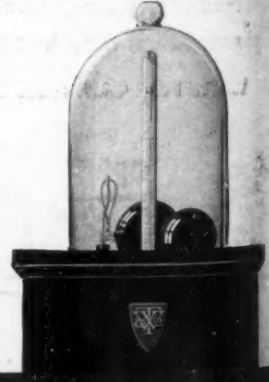

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